NONE FOR 1945
SEE TABLE OF
CONTENTS

1946

ANNUAL REPORT

A Report of Progress in Forest Research

U.S. Department of Agriculture
Forest Service

Northeastern Forest Experiment Station
Bankers Securities Building
Philadelphia 7, Pa.

V.L. Harper, Director

NORTHEASTERN FOREST EXPERIMENT STATION
OFFICE LIBRARY

CONTENTS

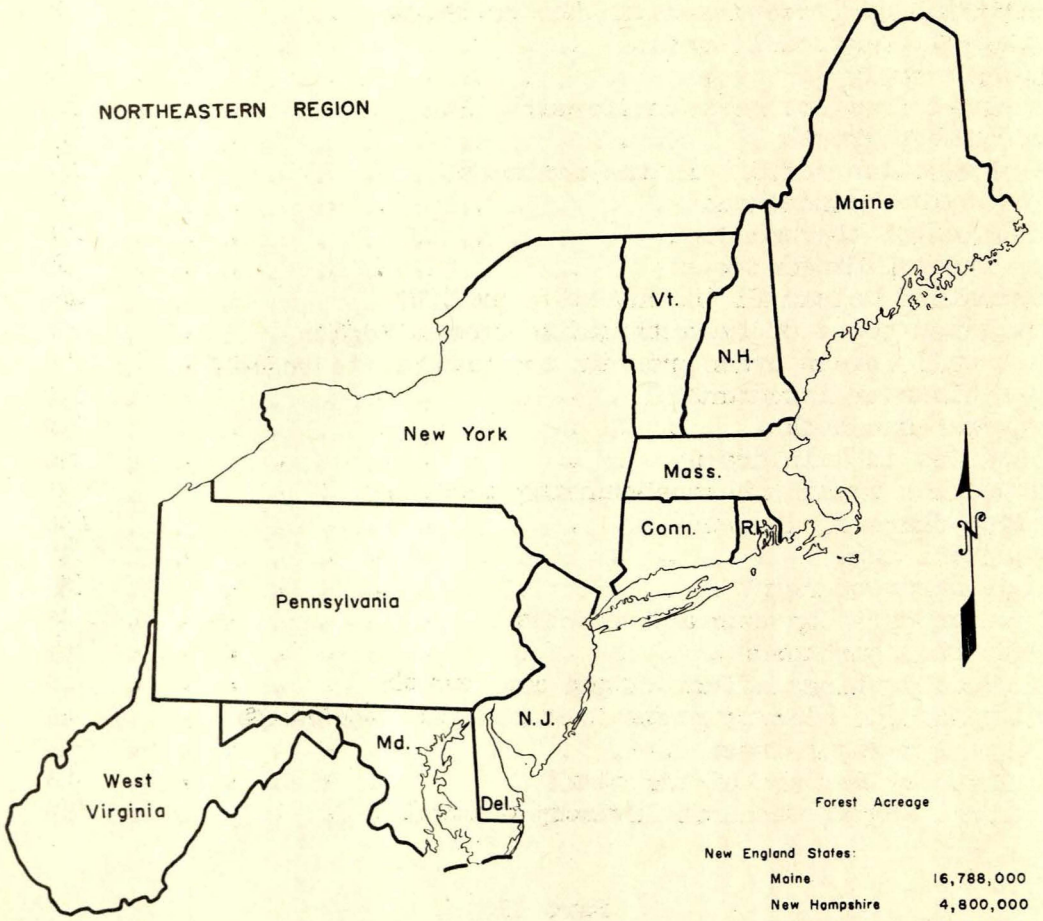
Part I

	Page
The annual report	1
The condition of forest lands in the northeast	7
Ownership of commercial forests	8
The timber supply	9
Timber drain from northeastern forests, 1944	12
Current timber growth	14
Lumber production deficit in the northeast	16
Wood waste in the northeast	18
Distribution of the budworm	20
Mapping budworm danger areas	22
Can overmature balsam fir be cut at a profit?	24
The mutilated goose of the anthracite forest region	26
How fast will forest trees grow in the anthracite region?	28
Is stump diameter important?	30
The loggers' handbook	32
Field courses in kiln drying	34
Kiln schedules to aid the wood-turning industry	35
Our ailing charcoal industry	36
Fire can be a tool	37
Why grade hardwood logs?	38
Effect of browsing by deer and rabbits	40
More pulp from hardwoods	41
How pulpwood cuttings affect output and growth	42
Tabacco poles and highway posts from red pine thinnings	44
Don't save low-vigor trees	45
Publications by members of the staff	46
Northeastern Forest Research Advisory Council	53

Part II

Station activities	55
Forest management	56
Forest insect investigations	68
Forest pathology	75
Forest economics	77
Forest utilization	81
Flood control surveys	83
List of research personnel	85

NOTE: Since no report for 1945 was issued except for administrative use, the results and publications included in this report apply to a 2-year period.



Forest Acreage

New England States:	
Maine	16,788,000
New Hampshire	4,800,000
Vermont	3,835,000
Massachusetts	3,310,000
Rhode Island	452,000
Connecticut	1,907,000
Total	31,092,000
Middle Atlantic States	
New York	13,500,000
Pennsylvania	15,228,000
New Jersey	2,348,000
Delaware	442,000
Maryland	2,742,000
West Virginia	9,954,000
Total	44,214,000

THE ANNUAL REPORT

of the

NORTHEASTERN FOREST EXPERIMENT STATION

The Northeastern section of the United States contains about 30 percent of the country's total population but less than 7 percent of its land area. Manufacturing and commerce dominate the economic landscape as in no other part of the nation; but, even so, most of the land is vitally needed for all that it can produce. About 59 percent of this land is suitable chiefly for growing timber and other forest products. At present this land produces only a fraction of the lumber, pulpwood, and other timber products that the Northeast consumes. Continuing supplies of these materials are essential. Where will they come from?

In addition to forest products, the forests contribute other valuable services. Watershed cover is highly important. The proud cities of Babylon and Assyria disappeared largely because the forest cover in the upper reaches of the Tigris and Euphrates rivers was destroyed. A similar disregard for watersheds in the Northeast would inflict unlimited trouble on its cities and industries and commerce. The forests also provide recreational opportunities sorely needed by people who live in metropolitan communities. An abundance of wildlife is another value that can be had only by conservation of forests and farm woodlands. All these values are inextricably bound together in the maintenance of healthy and productive forest lands.

A World-wide Problem

These problems in the Northeast are not unrelated to problems elsewhere. People everywhere in the world are hungry for timber products. War destruction in Europe and in eastern Asia has put on mankind a reconstruction job far larger than any ever seen before. Farmsteads and dwellings by the millions, factories, railroads, and harbors have been laid waste: whole cities need to be rebuilt before peoples can return to tranquil ways of life. Beyond this elementary demand for the repair of war damage lies the urgent need for a universal rise in living standards. Failure to move toward this goal would gravely endanger the peace that has been so dearly won. These needs cry for timber products of one kind or another.

About 60 percent of the softwood timber upon which the world depends for its construction material is in North America and Europe. Most of the other softwood forests are in Soviet Asia --relatively inaccessible. The only other large timber reserves are in the Tropics, where hardwood species dominate and where large-scale timber production is still undeveloped.

In short, the world timber situation indicates that the United States must look to its own timberlands for present and future supplies of wood products. We cannot expect large imports from abroad. A sizeable export of timber products by the United States would be a nice contribution to world unity; but unfortunately we have had a wood deficit for many years. Our modest export of lumber before the war was more than offset by large imports of pulpwood, wood pulp, and paper.

In the United States, a Timber Decline

The commercial forest land of the United States amounts to about 460 million acres. If well managed, this acreage could produce all the timber we need. The present situation, however, is cause for real concern. Recent estimates indicate that the present growing stock is far short of what we need to maintain the present cutting rate. We are cutting our timber faster than it grows. Another 20 years at the 1944 pace will leave us with far less saw-timber volume than we have today. On the other hand, a prosperous United States could consume far more timber products than we produced in 1944. All the evidence points to the steady development of a timber scarcity in the United States.

The Technical Committee on Forestry of the United Nations Interim Commission on Food and Agriculture notes that:

> "Historically, nations travel the same path in dealing with their forests. In countries of abundant timberlands and sparse population, all energies are directed to exploitation and a reckless use of what nature has so abundantly provided...but as populations grow and industry expands the demand for raw material increases and the scarcity of forests makes itself felt, then, and not until then, arises a slow, reluctant awareness of the need to protect and restore the forests."

The Northeast should have run this course years ago. Only modern transportation postponed the timber scarcity in the Northeast; it made available the timber of the Lake States, the South, and the West. Now the time has arrived when these regions also have run the course or are beginning to. Their vast resources of

timber have been badly depleted. At the same time their populations and their industries have grown. Now the regions that have been supplying timber products to the Northeast are confronted with their own dwindling resources and expanding local needs.

In the Northeast, Low Production

The world and the national situations both indicate that the Northeast will have more and more trouble in making up its great timber deficit by drawing from other regions. This points to the urgent need for increasing the production of our own forests. How big is this job?

In the 20-year period 1922-42, New England produced only 35 to 50 percent of the softwood lumber it consumed. The Middle Atlantic States produced only 2 to 10 percent of what they needed. In hardwood lumber, they did a little better: New England produced between 50 and 75 percent, and the Middle Atlantic States about 33 percent. About one-third of the pulpwood consumed by Northeastern paper mills has been coming from Canada. Even in the past, the forests of the Northeast have fallen far short of meeting our timber-product requirements. Now we need even greater supplies of timber products to meet housing shortages, paper shortages, and a host of other needs.

Low as the Northeastern production has been (in comparison with consumption), it still results in deterioration of the forest growing stock. According to recent estimates, the present saw-timber stand is only about half of what the land could produce. If we continue to cut at the 1944 rate, and with present cutting practices, the saw-timber volume in New England will decrease about 16 percent in the next 20 years. In the Middle Atlantic States (where production has been low because of scarcity) the trend would be a 14 percent increase in saw-timber volume. For the Northeast as a whole, under these conditions, the saw-timber volume 20 years from now will be at the same low level as it is now. Obviously this will not be enough. There is an incontestable need: rapid improvement in forest management.

Protecting our Forests

One aspect of forest management is protection. In fire protection, few regions of the United States have a record better than the Northeast. It is spotty, however, excellent in some states and hopeful in others. The annual burn approximates one-half of 1 percent of the protective area on the average. Considering that many of the fires are of the light surface variety, the damage from fire is not a serious obstacle to growing forests except locally. Improvement in forest-fire control should continue

and may ultimately reduce the burned area to about one-half the present amount, or one-fourth of 1 percent. Protection costs are mounting. With improving protection, there will be need to increase the efficiency of the fire-protection dollar. This implies better use of fire weather measurements to permit better organization of the fire-control forces, and continued improvement in fire-fighting techniques. These are recognizable objectives towards which progress is being made. It should be speeded up. Studies of fire damage are needed to aid in determining justifiable protection costs and to fix the point of diminishing returns.

Unlike fire control, the protection against insects and tree diseases is far from adequate. Annual losses over the past 10 years have averaged more than 10 percent of the total timber drain. Two epidemics are seriously threatening at the present time. One is the spruce budworm, which has recently been causing tremendous damage in Canada. It is now active in the Adirondacks of New York State. Another budworm attack like the one that swept Maine in 1910-20 might easily destroy a third of a half of the spruce-fir pulpwood stand and close many important pulp mills. The second infestation is the bronzed birch borer, beech scale and the accompanying nectria disease. These are associated with what is termed a "decadence" problem. The real role played by such insects and diseases is not understood, but is believed by many to be secondary. But whether caused primarily by pests or by unsatisfactory forest conditions, the fact is that heavy destruction of birch and beech is occurring in northern New England.

The weapons that come most readily to mind in meeting these attacks include all of those developed by the entomologists -- insecticides, parasites, etc. These are important. Even more basic than this strategy, however, are the practices that build up the natural resistance of the forest stand. This has not been emphasized enough. Healthy forests in full vigor, properly managed and utilized, are not conducive to the increase of forest pests. Unfortunately, the Northeastern forests are not in this condition, and progress to attain it will necessarily be slow. The Northeast must look forward to one of two courses -- great efforts at control or heavy destruction.

Timber-cutting Practices

The second major element in forest management is timber-cutting practices. Cutting practices are doubly important in the Northeast, for through them forest stands can be made more resistant to insects and diseases as well as made more productive. Here the Northeast lags behind the South to a notable extent. Pressure on the resource by industries that critically need timber supplies is one explanation. Lack of technical knowledge on how to cut the forests is another. This is primarily due to insufficient field

services to forest owners, and, to the lack of basic technical knowledge adapted to practical application. When forestry practice really begins, the need for research becomes most evident. There is, of course, a growing fund of technical knowledge in fields such as silvics, soil science, genetics, entomology, pathology, etc. The real job of integrating this knowledge with the economic realities of markets, logging and processing methods, pressure on the timber resource, and such, has not yet progressed very far. Too often in the past it has been erroneously assumed that research is away ahead of practice. This has not been the case.

A New Era in Forest Research

The general situation summarized above leads to the opening of a new era in the development of forest research in the Northeast. All agencies concerned are conscious of it, and are anxious by cooperative effort to push ahead and find the "know how" that is needed to solve the forest problem. Surveys, experimental cuttings (both on sample plots and on commercial scale), accompanied by project studies on special problems in forest management, laboratory and pilot-plant work on products, etc., are the tools for the job.

The following report briefly describes the Forest Service's part of the research job and gives a few examples of the new information that has been developed. Prior to the war the research work of the Forest Service in the Northeast was carried on chiefly by two forest experiment stations. Now there is one station carrying on a program which is rooted in 11 actual or prospective research centers, each one located in an important forest province of the region and all bound together under a correlated northeastern regional approach to problems.

New features of the research program include the Forest Survey now under way on a scale which should assure completion within 5 years. New techniques, based partly on the use of aerial photography, are giving reliable information for smaller areas than has heretofore been feasible in such overall surveys.

The threatened attack upon the spruce-fir forests of the Northeast by the spruce budworm has already been mentioned. If the insect behaves as it has in Canada over the past 6 or 8 years, very heavy damage will result. The Station, in cooperation with the Bureau of Entomology and other agencies, is busily engaged in developing timber-cutting practices and plans to improve the natural resistance of spruce-fir stands to budworm attack and to utilize some of the most vulnerable timber before it is killed by the insect. Preparations to meet the onslaught are, so far,

woefully inadequate. The Station does occupy a strategic sector in the defense line that has so far been thrown up to ward off this new menace which threatens to play havoc with the pulp industry of the Northeast.

The ending of the war has made it possible to resume work on flood control surveys. This Station and the Soil Conservation Service are charged with the conduct of these surveys and with the investigation of watershed management practices and their influence upon the water runoff.

A fourth major feature in the Station's current program is its Forest Utilization Service. This unit of three technical men devotes full time to timber-utilization problems. A Northeastern Loggers' Handbook is being prepared; 12 sections have been published in a preliminary edition and the final 4 are in process. Seasoning problems of small wood-using industries, turneries in particular, are being studied in collaboration with the Forest Products Laboratory. Another major job, also being done in collaboration with the Forest Products Laboratory, involves a survey of the possibilities for increased use of hardwoods in pulp manufacture.

A few highlights of these and other studies are given in the pages that follow.

THE CONDITION OF FOREST LANDS IN THE NORTHEAST 1/

Of the total land area in the Northeastern states, 57 percent (or 72.4 million acres) is classified as commercial forest. Another 2 percent (2.9 million acres) included in parks, preserves, and the like, is classified as noncommercial forest. Virtually all of the commercial forest acreage has been cut over one or several times. Almost all of it is potentially capable of growing substantial crops of good-quality timber. This production level can be attained if some of the present adverse conditions are remedied.

About 40 percent of the commercial forest acreage is occupied by stands of saw timber with 2,000 board feet per acre or more in trees of 9-inch diameter, or larger (11 inches for hardwood). Much of this stand, unfortunately, is in old decadent hardwoods left from previous cuts and in young trees which are just reaching the age of maximum growth. Continued cutting of the overmature hardwood is highly desirable, but in too many cases this cannot be done profitably without taking the immature second growth saw timber as well. The dilemma is most difficult. Failure to solve it in the past has been one of the basic causes of deterioration in the forest growing stock.

Pole-timber stands, with a volume of 5 cords per acre or more, occupy 28 percent of the commercial forest acreage. Scattered saw-timber trees occur in many of these stands but the volume per acre is usually not sufficient to permit profitable operation for saw-timber alone. In areas where there are ready markets for cordwood, the growth rate of pole-timber forests could be raised considerably by thinning and other stand-improvement practices. The great need at present is to find economical ways for logging and utilizing low-quality timber and small stems thinned from the young growing stock.

About 19 percent of the commercial forest acreage is occupied by seedlings and saplings covering 40 percent or more of the growing space. Lands in this condition are, of course, the heritage of board-scale clear-cutting. The volume increment of annual growth is very low. Short-run gain that results from such cutting practices is lost many times over by the long-term reduction in land productivity.

The remaining 13 percent of the commercial forest acreage is poorly stocked with seedlings and saplings or totally denuded of all tree growth. Some of this area will be useless for timber growing purposes for generations unless it is planted.

The fact that only 40 percent of the commercial forest acreage bears saw timber of 2,000 board feet per acre or more would suggest that a very large acreage of forest land might be in an inactive status. This is not the case. About 85 percent of the acreage shows signs of recent cutting. Obviously, the timber resource is under heavy pressure with much cutting in the immature stands.

1/ Reappraisal Information.

OWNERSHIP OF COMMERCIAL FORESTS 2/

The commercial forest land in the Northeastern states amounts to 72.4 million acres. Of this total, 65.8 million (91 percent) is in private ownership. The other 6.6 million (9 percent) is held by the Federal Government, by the states, and by counties and municipalities.

About 70 percent of the total acreage is in small private holdings of 5,000 acres and less. The number of such properties is estimated at 758,000. The majority (469,000) of these small properties are in farm woodlands. The average is 39 acres per farm and the total farm woodland acreage adds up to 18.3 million acres or 25 percent of all commercial forest land. The small nonfarm owners number 209,000 and their aggregate holdings amount to 32.0 million acres or 45 percent of all commercial forest land. The average holding of this kind is 153 acres.

There are about 310 private holdings that contain between 5,000 and 50,000 acres. The acreage held by this class of owners amounts to about 5 percent of the total or 3.9 million acres. Properties of 50,000 acres and more number 70. They contain an aggregate of 11.6 million acres or 16 percent of the commercial forest land.

Forest land ownership by interests that operate wood-using plants is surprisingly limited. Lumber manufacturers own 3.7 million acres, only 5 percent of the total commercial forest acreage. The lands held by pulp manufacturers total 7 million acres or 10 percent of the total. The acreage held by other wood-consuming industries is doubtless quite small.

The fact that 45 percent of the commercial forest land acreage is held by small private owners who are neither farmers nor persons actively engaged in the business of forest products manufacture points to one very difficult problem. Out of the 209,000 small owners of this type, there is a large proportion who have nothing but a cash interest in their land holdings. Public and private educational programs for the improvement of forest management practices cannot reach them effectively because so many are absentee owners.

The public holdings of commercial forest land are distributed as follows: states, 3.8 million acres; national forests and other federal, 2.4 million acres; counties and municipalities, 0.4 million. The percent of total acreage in the three types of public ownership are: states, 5 percent, federal government, 3 percent, counties and municipalities, less than 1 percent.

2/ Reappraisal Information.

THE TIMBER SUPPLY 3/

The volume of timber on commercial forest lands of the Northeast is estimated at 52 billion cubic feet. Of this total, 17 billion are in softwoods and 35 billion are in hardwoods. When white men first arrived, the softwood volume was probably about equal to that of hardwood. The drastic change in species composition reflects the preference for softwoods in many forms of timber use.

Trees of saw-timber size (9 inches d.b.h. and upward for softwoods, and 11 inches for hardwoods) contain 29 of the 52 billion cubic feet. About one-third is softwood. The remaining 23 billion cubic feet are in pole-timber trees and of this, slightly less than one-third is softwood.

In board-foot measure, the saw-timber volume amounts to 120 billion board feet. Species composition is as follows:

Species	Billion board feet
Spruce and fir	23
Pines	15
Hemlock	9
Total softwoods	47
Beech, birch, and maple	40
Oak	21
Poplar and aspen	5
Other	7
Total hardwoods	73

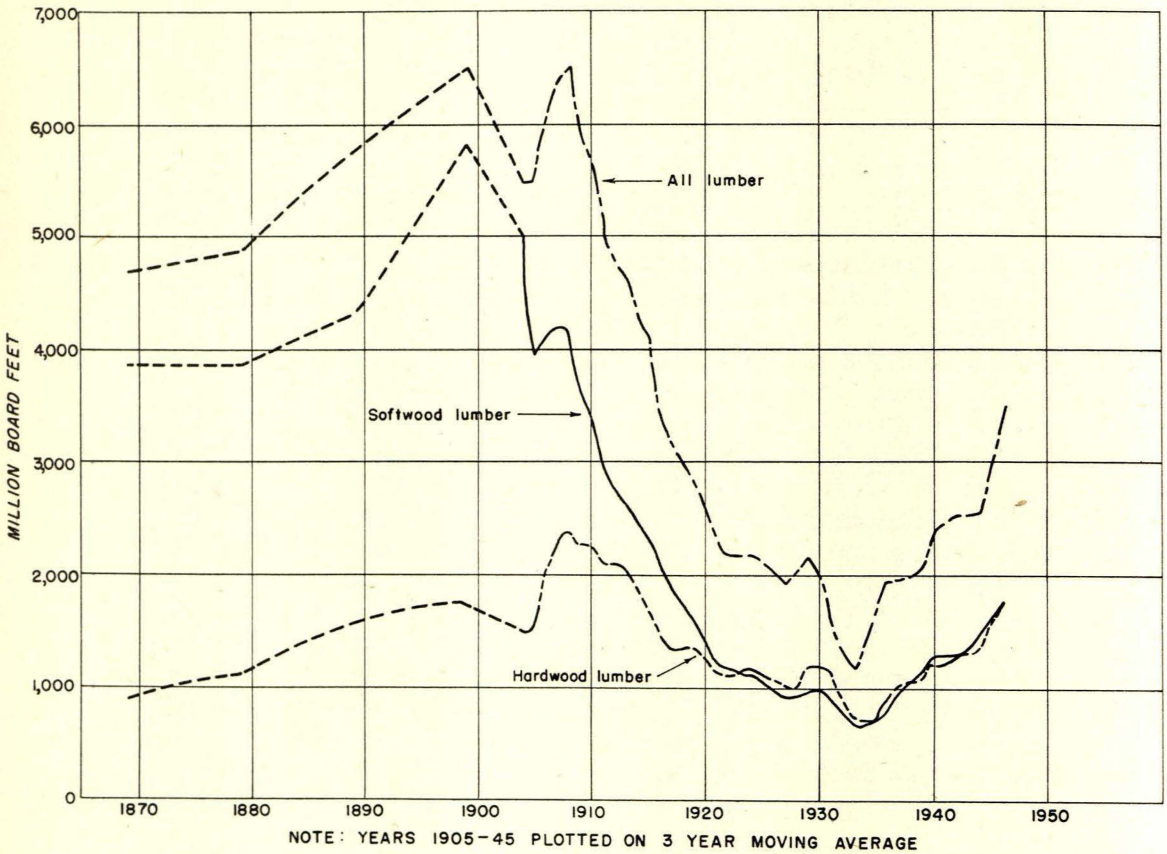
A little more than half the total saw-timber volume is in the northern hardwoods (beech, birch, maple) and in the oaks. These species are valuable for dimension, flooring, many factory uses, cooperage, and railroad ties, but none of them rate very high as lumber for construction or for boxes and other rough containers. The comparatively small reserve volume of pine and hemlock indicates severe pressure on timber suitable for construction and containers. The Northeast uses a huge volume of this kind of material.

In addition to the sawlog volumes listed above, there is also volume in the tops and limbs of saw-timber trees and in the sound portion of cull trees. The total volume in this kind of wood is estimated at 218 million cords. Unfortunately, most of it is of low commercial value. A high percentage of it gets left in the woods after logging operations.

In terms of cords, the pole-timber volume amounts to a considerably larger quantity - 342 million cords. Most of this, of course, is in young timber that should not be heavily cut until it has attained a greater size.

3/ Reappraisal Information.

TREND OF LUMBER PRODUCTION IN NORTHEASTERN STATES 1870-1946



NOTE: YEARS 1905-45 PLOTTED ON 3 YEAR MOVING AVERAGE

Lumber production in the Northeast, 1869-1946

(In million board feet)

Year	New England[1]			Middle Atlantic[2]			Entire Northeast		
	Soft-woods	Hard-woods	Total	Soft-woods	Hard-woods	Total	Soft-woods	Hard-woods	Total
1869	1,246	154	1,400	2,558	675	3,233	3,804	829	4,633
1879	1,290	169	1,459	2,514	853	3,367	3,804	1,022	4,826
1889	1,426	290	1,716	2,779	1,220	3,999	4,205	1,510	5,715
1899	1,927	276	2,203	2,853	1,431	4,284	4,780	1,707	6,487
1904	1,795	245	2,040	2,191	1,227	3,418	3,986	1,472	5,458
1905	1,428	262	1,690	1,967	1,047	3,014	3,395	1,309	4,704
1906	2,065	393	2,458	2,209	1,498	3,707	4,274	1,891	6,165
1907	2,360	409	2,769	2,191	2,093	4,284	4,551	2,502	7,053
1908	1,975	418	2,393	1,671	1,655	3,326	3,646	2,073	5,719
1909	2,179	489	2,668	1,987	2,015	4,002	4,166	2,504	6,670
1910	1,586	383	1,969	1,694	1,668	3,362	3,280	2,051	5,331
1911	1,470	393	1,863	1,479	1,680	3,159	2,949	2,073	5,022
1912	1,585	396	1,981	1,315	1,736	3,015	2,900	2,132	5,032
1913	1,328	344	1,672	1,085	1,590	2,675	2,413	1,934	4,347
1914	1,652	314	1,966	1,005	1,700	2,705	2,657	2,014	4,671
1915	1,410	248	1,658	843	1,275	2,118	2,253	1,523	3,776
1916	1,391	246	1,637	797	1,237	2,034	2,188	1,483	3,671
1917	1,125	211	1,336	697	1,041	1,738	1,822	1,252	3,074
1918	1,032	188	1,220	560	899	1,459	1,592	1,087	2,679
1919	1,120	298	1,418	524	642	1,166	1,807	1,540	3,347
1920	753	188	941	529	1,024	1,553	1,282	1,212	2,494
1921	795	234	1,029	405	830	1,235	1,200	1,064	2,264
1922	637	153	790	375	813	1,188	1,012	966	1,978
1923	749	192	941	394	935	1,329	1,143	1,127	2,270
1924	743	201	944	386	903	1,289	1,129	1,104	2,233
1925	667	205	872	341	877	1,218	1,008	1,082	2,090
1926	649	185	834	322	842	1,164	971	1,027	1,998
1927	552	170	722	282	770	1,052	834	940	1,774
1928	595	170	765	267	726	993	862	896	1,758
1929	685	202	887	396	1,154	1,550	1,081	1,356	2,437
1930	653	183	836	318	952	1,270	971	1,135	2,106
1931	459	150	609	265	740	1,005	724	890	1,614
1932	320	92	412	184	423	607	504	515	1,019
1933	392	74	466	191	528	719	583	602	1,185
1934	494	105	599	188	553	741	682	658	1,340
1935	548	142	690	251	644	895	799	786	1,585
1936	689	159	848	329	891	1,220	1,018	1,050	2,068
1937	710	163	873	336	949	1,285	1,046	1,112	2,158
1938	538	139	677	240	596	836	778	735	1,513
1939	727	163	890	391	938	1,329	1,118	1,101	2,219
1940	764	166	930	376	981	1,357	1,140	1,147	2,287
1941	930	157	1,087	432	1,080	1,512	1,362	1,237	2,599
1942	891	144	1,035	397	1,051	1,448	1,288	1,195	2,483
1943	815	124	939	401	1,156	1,557	1,216	1,280	2,496
1944	955	132	1,087	417	1,200	1,617	1,372	1,332	2,704
1945	840	131	971	537	1,018	1,555	1,377	1,149	2,526
1946	1,185	184	1,369	555	1,570	2,125	1,740	1,754	3,494

1/ Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

2/ New York, Pennsylvania, New Jersey, Maryland, Delaware, and West Virginia.

Source: 1869-1928, Pierson and Reynolds, U.S.F.S. compilation; revised estimate 1929-41 by H. B. Steer, U.S.F.S.; Census Data 1942-46.

TIMBER DRAIN FROM NORTHEASTERN FORESTS, 1944 4/

Total timber drain from the commercial forests of the Northeast in 1944 is estimated at 1,607 million cubic feet. Of this total, 555 million cubic feet were from softwoods and 1,052 were from hardwoods. The percentage distribution by principal commodities and by chief destructive agents was as follows:

Type of drain	Percent of total volume
Commodity:	
Lumber	31.9
Fuel wood	26.0
Pulpwood	12.8
Mine timbers	8.6
Veneer logs	1.4
Hewed ties	1.1
Fence posts	.9
Cooperage stock	.6
Other commodities	5.2
Total	88.5
Destructive agents:	
Fire	1.4
Insects, disease, wind, etc.	10.1
Total	11.5
Total drain	100.0

The loss due to destructive agents is estimated on the basis of the annual average over the 10-year period, 1934-43.

The 1944 drain for lumber came about half from softwoods and half from hardwoods. This emphasizes the intense pressure upon the relatively small reserve stand of softwood.

Fuelwood is drawn quite largely from hardwood. Aside from the 18 percent that is cut from sawlog material, it presents no serious problem in forest drain.

Pulpwood production in 1944 stood at or near a peak level. It was, however, sufficient to provide only 65 percent of the region's consumption. This drain is heavily weighted by the softwood — 80 percent — and the pressure is almost certain to increase.

Mine timbers are the only other commodity that absorbs a considerable portion of the total drain. In this case the hardwoods are preferred. Continued production in adequate quantity presents no serious difficulty from the regional standpoint.

4/ Reappraisal Information.

Minor products like veneer logs, cooperage stock, tunery and handle stock do not bulk large in quantity but they are important from the quality and value standpoint. These are products which require substantial quantities of skilled labor in their manufacture. They occupy an important place in the forest economy of the region.

Loss from fire has been reduced to a reasonably low level, but much remains to be done in the control of insects and disease. The toll paid to these pests still stands at 10 percent of total annual timber drain.

Timber Drain from Northeastern Forests, 1944

Type of Drain	From timber of all sizes 1/			From saw-timber trees only 2/				
	All species	Softwoods	Hardwoods	All species	Softwoods		Hardwoods	
	Million cu.ft.	Million cu.ft.	Million cu.ft.	Million bd.ft.	Million bd.ft.	Percent	Million bd.ft.	Percent
Commodity:								
Lumber	513	240	273	2,225	1,065	89	1,160	98
Fuel wood	418	54	364	410	39	15	371	26
Pulpwood	206	166	40	747	656	79	91	60
Mine timbers	138	12	126	214	13	21	201	39
Veneer logs	23	1	22	99	8	100	91	100
Hewed ties	17	9	8	74	44	100	30	100
Fence posts	15	5	10	20	7	28	13	33
Cooperage stock	10	5	5	48	26	100	22	100
Other commodities 3/	84	13	71	275	48	74	227	84
Total	1,424	505	919	4,112	1,906	76	2,206	58
Destructive agency:								
Fire	22	5	17	26	6	24	20	32
Insects, disease, wind, etc.	161	45	116	370	108	48	262	71
Total	183	50	133	396	114	46	282	57
Total drain	1,607	555	1,052	4,508	2,020	73	2,488	59

1/ Includes all timber, cut or destroyed, from all trees over 5 inches d.b.h.

2/ Includes only sawlogs, cut from softwoods 9.0 inches d.b.h. and over, and hardwoods 11.0 inches d.b.h. and over.

3/ Includes logs and bolts for wood turning and other manufacture, shingle bolts, poles and piling, excelsior wood, distillation wood, toothpick bolts, etc.

CURRENT TIMBER GROWTH

Statistics of timber growth and drain often contain dangerous "booby traps". This is certainly the case now in the Northeast. Even the poorest kind of forestry practice could result in a rough balance between growth and drain. However, a growth-drain relationship has real meaning only when the forest land is actually growing trees at a rate reasonably near its full capacity.

In the Northeast 13 percent of the forest land is poorly stocked with seedlings and saplings, or is totally denuded; another 19 percent bears principally seedlings and saplings less than 5-inch diameter; and 28 percent bears at least 5 cords per acre but less than a light saw-timber stand. Growth is far short of what it could be if the land had an adequate growing stock.

In considering growth we can't disregard species and quality. A favorable growth-drain ratio is significant only if the growth is in the kind of timber that can be used economically. In 1944, 89 percent of the wood that went into the high-value products (lumber, pulpwood, veneer logs, hewed ties, cooperage stock, etc.) was cut from trees of saw-timber size. These products are the economic backbone of the wood-using industries. To survive, these industries must have saw timber.

The overcut in softwood saw timber is critical. In 1944 drain exceeded growth by 35 percent. In hardwood saw timber the situation isn't much better--even though the statistics show a surplus. Much of the growth is in species that are not merchantable as lumber or other high-grade products. A large part of the growth is in trees left in mixed stands after the softwoods and the choice hardwoods were cut.

Pole-timber growth exceeds drain by a comfortable margin. This is good. These are the potential saw-timber trees. The great problem is to prevent premature harvest cutting of these stands and to increase their rate of growth by stand-improvement cutting. If this could be done on a fairly large scale, the growth-drain ratio would gradually shift to a safer condition. If it is not done, the timber stands of the Northeast will continue to be depleted and deteriorated.

NEEDED: MORE SAW TIMBER

THE HIGH-VALUE WOOD PRODUCTS DEPEND ON SAW TIMBER:

Product	Percent cut from saw-timber trees		
	Softwoods	Hardwoods	Total
Lumber	41	52	93
Pulpwood	63	12	75
Veneer logs	11	89	100
Hewed ties	52	48	100
Cooperage stock	50	50	100
Other products 1/	14	72	86
All high-value products	44	45	89

1/ Not including fuel wood, mine timbers, and fence posts.

...AND SAW-TIMBER GROWTH IS FAR SHORT OF WHAT IT SHOULD BE:

Relationship of growth to drain

(Million cubic feet)

Kind of timber	Growth	Drain	Deficit	Surplus
Saw timber:				
Softwood	301	405	104	---
Hardwood	750	621	---	129
Total	1,051	1,026	---	25
Pole timber:				
Softwood	391	150	---	241
Hardwood	852	431	---	421
Total	1,243	581	---	662
All timber:	2,294	1,607	---	687

LUMBER PRODUCTION DEFICIT IN THE NORTHEAST

Even prior to the wartime shortage, the demand for lumber in the Northeast exceeded the regional production by a wide margin. Of the softwood lumber consumed in New England not less than 30 and not more than 53 percent came from the region's own forest in the 20-year period 1922-42. Of the hardwood lumber, not less than 48 percent nor more than 74 percent came from the local forests.

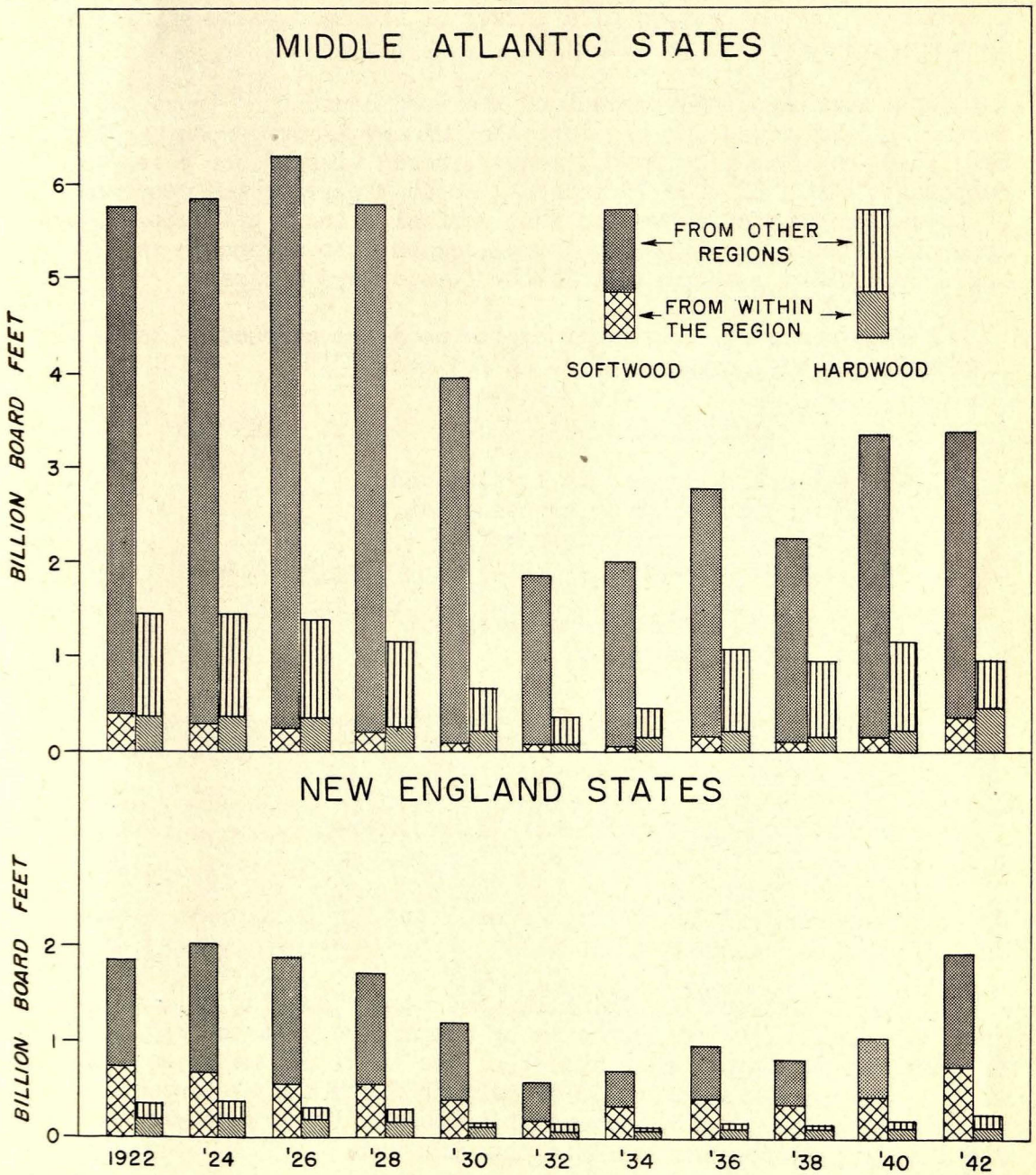
The Middle Atlantic States consume a much larger volume of lumber but the local forests supply even a smaller percentage. In softwoods they have furnished as little as 2 percent and only once in the 20 years, as much as 10 percent. Less than one-third of the hardwood lumber consumption has been met by local production. This is not a very creditable showing for what is potentially one of the best hardwood-producing regions of the country.

The fact that the Northeast has such a great deficit in lumber production does not by any means imply that the region should strive for self-sufficiency. It does show, however, that the long-term regional demand for saw timber and for quality lumber will far outrun regional production. Proximity to so large a market gives the Northeastern producer one important advantage over his competitors in the South and West. It argues also for a rapid improvement in the quality of timber grown and in the manufacture of the lumber product. Lumber-marketing troubles in the Northeast are due not to small demand, but rather to poor quality. Northeastern lumber cannot compete with the better-processed and better-quality material that comes from other regions. Decades will be required to improve the quality and to increase the quantity of timber, but manufacturing processes can be improved quite rapidly.

In an effort to improve lumber-manufacturing processes, the Station -- aided by a specialist from the Forest Products Laboratory -- has made a survey of typical small sawmills and sawmill manufacturers in the Northeast. As a result of this and other surveys, the Laboratory has started a basic study of rates of saw speed and carriage feed as related to saw tooth pattern and sharpening technique. Meanwhile, the Station, with technical guidance from the Laboratory, is answering questions from sawmill men, such as these: "How can I improve my mill layout?" "Would a resaw fit in my mill?" "How far can I economically go in sorting for grade?" In addition, in response to a widespread need, Forest Products Note No. 2 describing simple and efficient ways of loading lumber at the rear of small sawmills has been issued.

APPARENT LUMBER CONSUMPTION

1922-1942



Source: U. S. Forest Service. Domestic Lumber Consumption and Distribution. Annual and biennial report. Washington, D. C.

WOOD WASTE IN THE NORTHEAST

More complete utilization of the timber harvest has long been advocated by foresters. Notable achievement in this line is recorded in the results of a survey of the wood waste situation in the Northeast made in 1945.

Approximately 75 percent of the wood content of trees harvested in 1944 found its way into the primary timber products: lumber, fuel, cordwood, pulpwood, veneer, hewed ties, fence posts, cooperage, etc. Of this 75 percent, about 3 percent was composed of so-called "waste" converted into nonfuel primary products, e.g., tops of softwood trees into pulpwood, slabs into dimension stock, and shavings and sawdust into litter for poultry houses.

The remaining 25 percent of the wood was classed as waste material. It was composed about as follows:

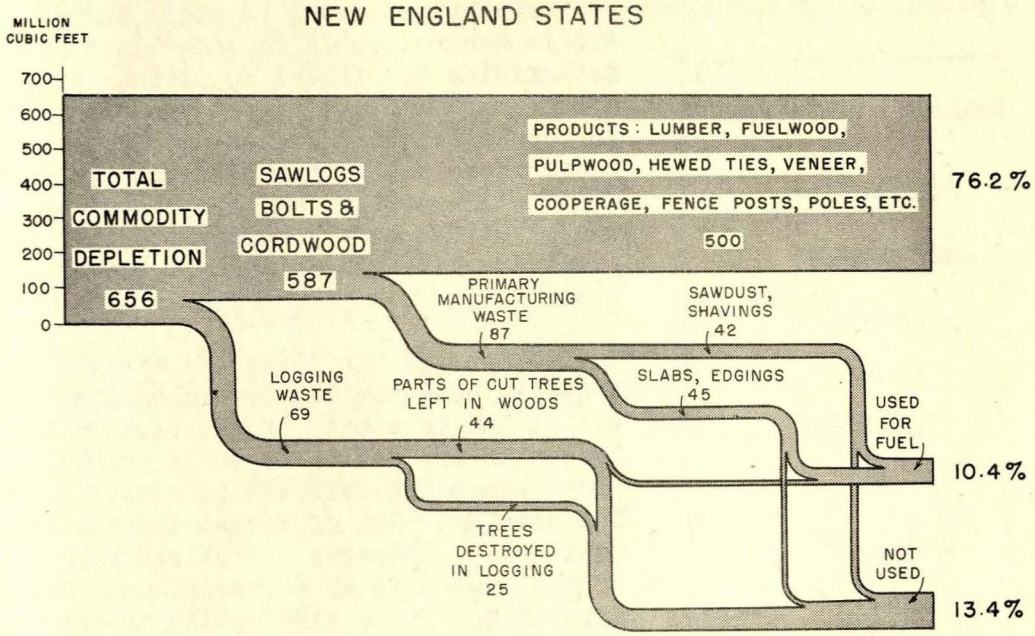
Type of material	Percent
Uncut trees destroyed in logging and standing trees left so exposed that they will die or blow down before another cut is made.	4
Tops, limbs, and other parts of cut trees left in the woods.	7
Slabs, edgings, trimmings, and other coarse material at primary manufacturing plants.	7
Sawdust, shavings, and other fine material.	7

Of this waste material, 10 percent was used for fuel. The remaining 15 percent was not used at all.

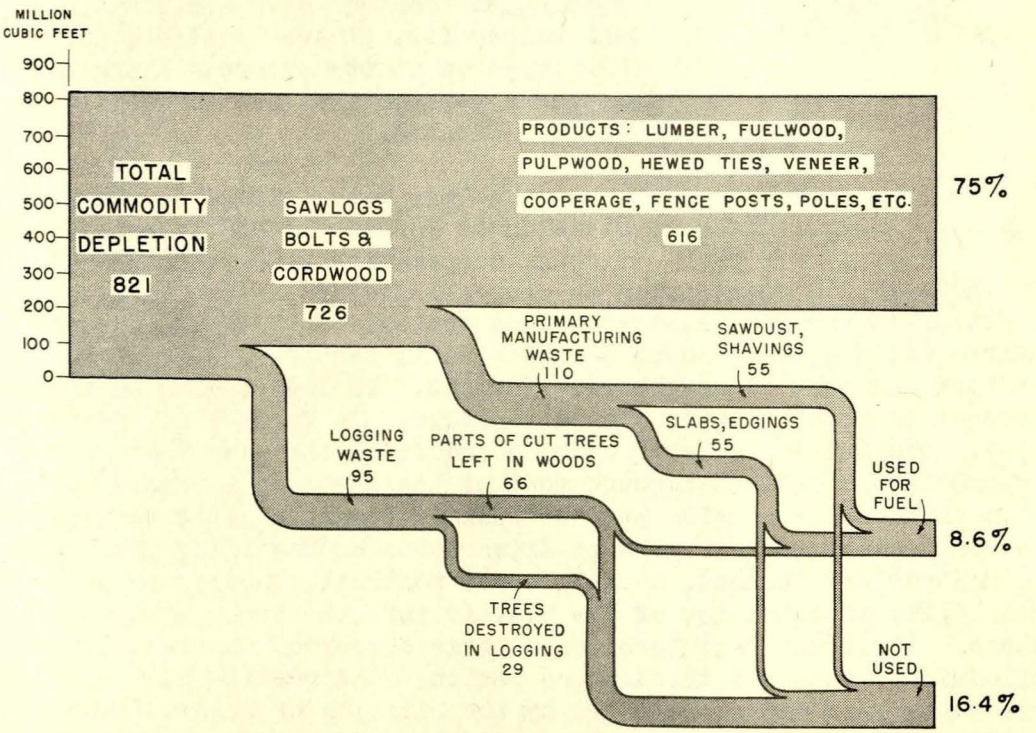
The notable extent to which wood waste is being utilized in the Northeast can be seen quickly by comparison with the wood-waste figures for the Nation as a whole: of the total volume of wood harvested, 51 percent appeared in primary products and 49 percent in waste materials. Of the 49 percent in waste, 16 percent was used for fuel and 33 percent found no economic use.

WOOD WASTE IN LOGGING AND PRIMARY MANUFACTURE OF ALL WOOD PRODUCTS- 1944

NEW ENGLAND STATES

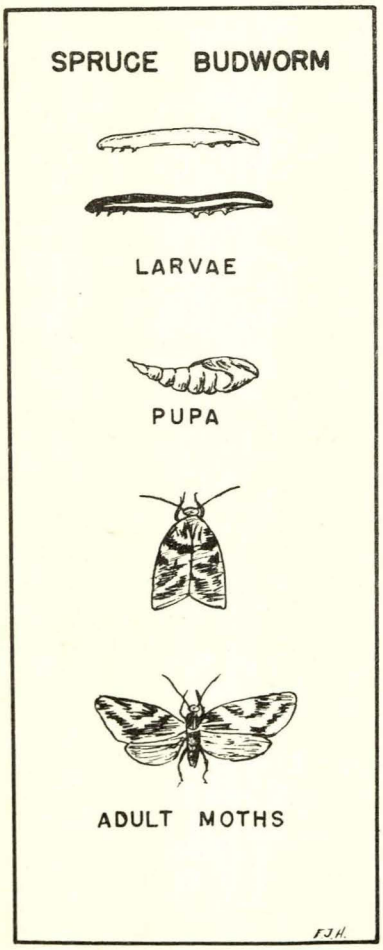


MIDDLE ATLANTIC STATES



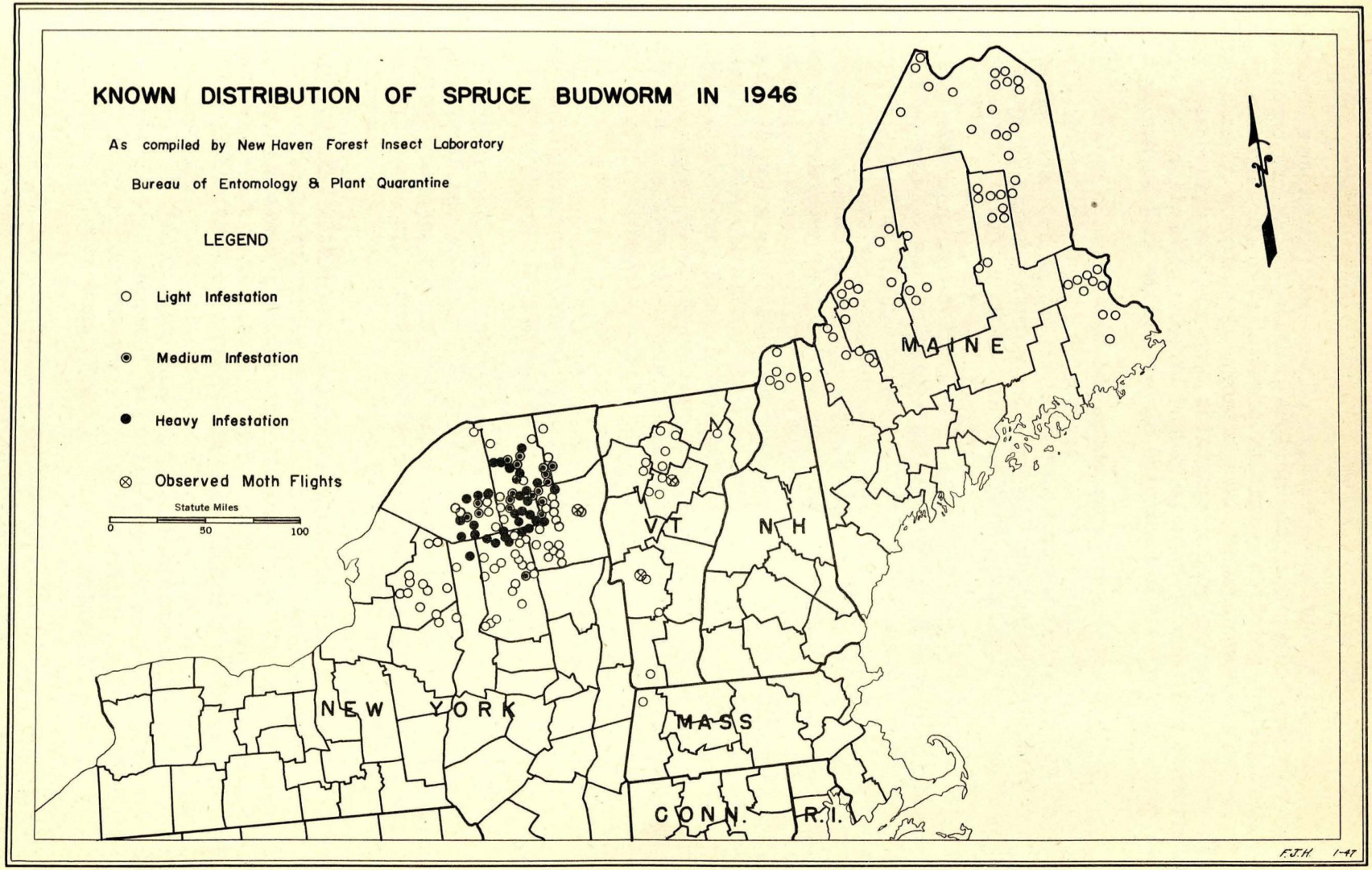
DISTRIBUTION OF THE BUDWORM IN THE NORTHEAST

Basic to any program of budworm control is knowledge of the insect's distribution, the location of centers of infestation, and the extension of the areas of heavy infestation. A still further aid in control would be some basis for determining the forest condition favorable for sudden and spectacular increases in population, and for predicting in advance where and with what force the epidemic will strike. These are some of the questions to which forest entomologists are giving much thought and attention.



Through the joint efforts of Canadian and American entomologists, the extent and intensity of the budworm infestation and the increase in populations are being followed in detail. The Dominion Division of Forest Insects Investigations reports a continued spread of the insect in an easterly and westerly direction. It is also moving to the north but at a reduced rate because of the barrier represented by extensive areas of black spruce on which the insect is less apt to build up to damaging population than on white and red spruce, and balsam fir. There is also a definite slowing-down in its progress along the southern periphery of the infestation in eastern Ontario.

The New Haven office of the Federal Division of Forest Insects Investigation, through cooperation with state agencies and industry, is maintaining an over-all picture of the infestation situation in the Northeastern United States. In 1945 the spruce budworm was discovered over a wide area in the Adirondack region of New York and most of neighboring Vermont. In 1946 came a tremendous increase in population in the Adirondacks. In Vermont no increase was noted. The survey in New Hampshire and Maine the same year showed budworm larvae present through most of the spruce-fir region but nowhere in these two states was the budworm found in large numbers. However, heavy moth flights at Elizabethtown, New York, and Rutland and Montpelier, Vermont, as well as at Montreal, Quebec, point to the probability of extension of the heavily infested areas in the near future. These data are based on a large number of observations and collections scattered through the region. The results of the survey were summarized and coordinated by the Division of Forest Insects Investigations at New Haven, Connecticut.


KNOWN DISTRIBUTION OF SPRUCE BUDWORM IN 1946
As compiled by New Haven Forest Insect Laboratory
Bureau of Entomology & Plant Quarantine
LEGEND
Light Infestation
Medium Infestation
Heavy Infestation
Observed Moth Flights
Statute Miles
0
50
100
MAINE
VT
N H
NEW YORK
MASS
CONN.
R.I.
F.J.H. 1-47

MAPPING BUDWORM DANGER AREAS

One of the prime objectives of research in budworm control is to reduce losses from the serious budworm attack now threatening. Research points to sanitation cuttings as our main forest-management defense against this attack. The purpose of such cuttings is to develop stand conditions that will be unfavorable for budworms; and thus we hope to reduce budworm populations to a level where losses to the remaining timber stands will be negligible.

Such a cutting program should be based on the relative vulnerability of various types of spruce-fir stands to budworm attack. As many high-hazard areas as possible should be cut over before the insect causes serious losses. Such areas provide favorable conditions for the increase of the insect to epidemic proportions.

The first step in such a program is to map and classify spruce-fir forests into degrees of vulnerability. Using forest-type maps and aerial photographs supplied by industry and state and Federal agencies, the Station is classifying and mapping the entire spruce-fir region. Such maps provide an excellent general picture of the budworm hazard situation and the problem of accessibility. For classifying individual holdings a more refined but simple method for rating the vulnerability of any given stand was needed. This would permit land owners to classify and map their timberlands by budworm hazard zones, and would give them a sound base for a "danger zone" priority-cutting plan. To meet this need the Station developed a simple formula for rating a stand's vulnerability:

Vulnerability = V x BA
(V = balsam fir volume in cords per acre; BA = basal area of the average balsam fir at breast height).

The formula has been used successfully in classifying and mapping some 800,000 acres of National forests in the Northeast. Private industry is also experimenting with its use; and one pulp and paper company in Maine has used the formula in classifying its entire holdings of some 425,000 acres.

As an example, Franconia Township in Grafton County, New Hampshire, was broken down into budworm vulnerability classes through the use of the formula. This township contains approximately 21,500 acres of private forest land. Analysis of map and cruise data shows the following distribution of hazard classifications:

High vulnerability	- 22 percent
Medium vulnerability	- 5 percent
Low vulnerability	- 40 percent
No hazard	- 33 percent

Experience indicates that a skilled man can do the essential field work, compile and analyze the data, and prepare the detailed vulnerability map at the rate of approximately 20,000 acres per month.

RELATIVE VULNERABILITY OF FORESTS TO BUDWORM ATTACK

PORTION OF FRANCONIA TOWNSHIP, N.H.

A BUDWORM PROBLEM:

CAN OVERMATURE BALSAM FIR BE CUT AT A PROFIT?

Large, overmature balsam fir trees are ideal places for large budworm populations to grow rapidly. On many woods operations in the Northeast, these overmature firs are left standing. Cutters claim that their long experience and shrewd instinct enable them to distinguish these trees as unmerchantable. Through long usage this practice has become an established policy, and it is extremely difficult to get cutters to fell these trees.

Because these trees are such great budworm hazards, they should be cut wherever possible, regardless of the amount of merchantable wood they contain. Prompt and extensive application of such a cutting policy would help greatly to combat budworm breeding conditions, and ultimately to reduce the damage from these pests.

To determine whether it is commercially practical to cut these budworm-hazard trees, the Station is trying to find out how much sound, salvageable wood there is in defective balsam firs of various sizes; the cost of harvesting such trees; and their ultimate pulpwood value.

Findings of the studies indicate that the cutters' judgment and instinct is not infallible; and that a good deal of sound wood is left standing. For example, a 13-inch balsam fir containing 15 percent of cull has just as much pulpwood value at the roadside as a sound 10-inch tree. Cull of 30 and 50 percent would put such a tree in the same value class as sound 8- and 6-inch trees respectively.

Thus, if an operator's pulpwood-cost production figures show that he can't profitably cut trees below the 8-inch diameter class, the maximum amount of defect he could allow in balsam firs would be about as follows:

D.b.h. size class (Inches)	Maximum allowable defect (Percent)
9	15
10	20
11	25
12	30
13	30
14	35
15	35
16	40

On this basis, the operator could harvest 9-inch balsam firs with rot ranging up to 15 percent--at a profit. Trees 12 and 14 inches in diameter would have to contain more than 30 and 35 percent cull respectively before his profit margin would disappear.

Roadside pulpwood value of defective balsam fir trees, expressed in size of sound trees of equivalent pulpwood content

D.b.h. (inches)	Percent of cull										
	0	5	10	15	20	25	30	35	40	45	50
	Diameter of sound tree in inches										
6	6.0										
7	7.0	6.7	6.4	6.0							
8	8.0	7.6	7.3	6.9	6.5	6.1					
9	9.0	8.6	8.1	7.7	7.3	6.9	6.5	6.0			
10	10.0	9.4	8.9	8.4	7.9	7.5	7.0	6.5	6.1		
11	11.0	10.3	9.6	9.0	8.5	8.0	7.5	7.0	6.5	6.0	
12	12.0	11.0	10.2	9.6	8.9	8.4	7.8	7.3	6.8	6.3	
13	13.0	11.8	10.8	10.0	9.3	8.7	8.1	7.6	7.1	6.5	6.0
14	14.0	12.7	11.5	10.6	9.8	9.1	8.5	7.9	7.3	6.8	6.2
15	15.0	13.7	12.5	11.3	10.4	9.5	8.8	8.2	7.6	7.1	6.5
16	16.0	14.5	13.2	11.8	10.8	9.8	9.1	8.5	7.8	7.2	6.6

THE MUTILATED GOOSE OF THE ANTHRACITE FOREST REGION

Recent studies of the condition of forest land in Pennsylvania's Anthracite Region present a dismal picture. The 3.2 million acres of forest have only 5 percent left in stands large enough to call saw timber. Three-fourths of the forest land is struggling against heavy odds to revive itself with tree reproduction. In some areas repeated fires prevent the reproduction of anything except scrub oak and other worthless species. The goose that lays the golden eggs isn't being decapitated--it's being slowly tortured to death by hacking and burning.

Three-fourths of the forest land, even if encouraged to do so, cannot produce anything for the present generation. A large portion of the remainder, the pole-timber areas, are being cut over as soon as a few tons of props become visible; smaller trees that dare to grow are cut for lagging. The forest resource is in such a battered condition that it grows each year only about 3 percent of what it could grow.

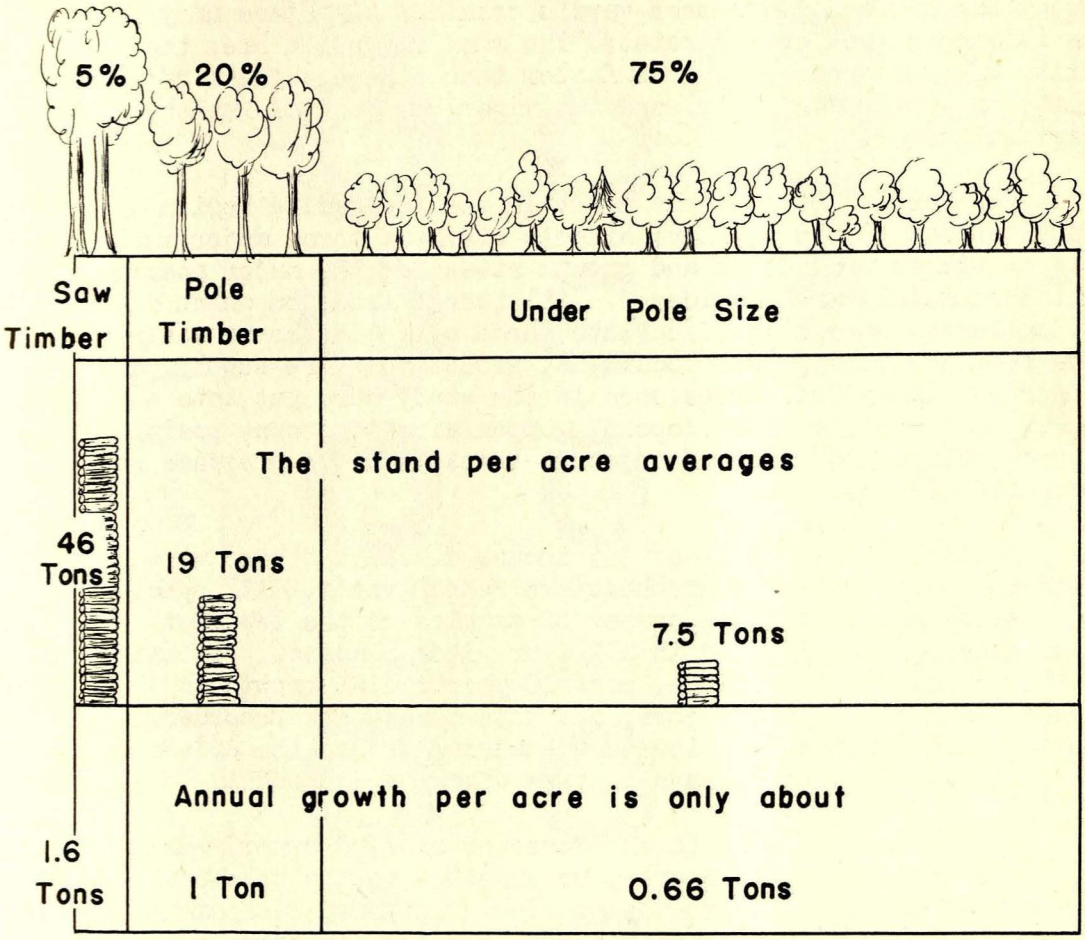
How much could it grow? About 70 million tons of props per year. In board feet, that is 1-1/4 billion. At $10 stumpage, that's a very nice golden egg.

Of course, it would take 40 to 60 years to bring that about. It would mean no fires; some planting; a lot of thinning for lagging and props (instead of clear-cutting); and final harvest cuttings on a partial-cut basis, leaving a good growing stock.

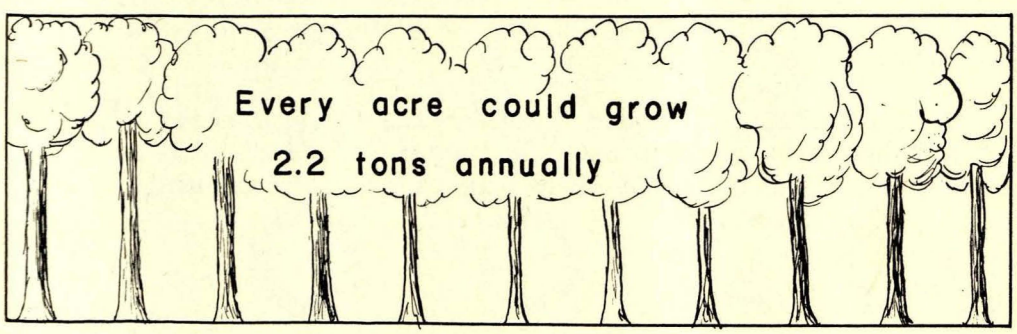
If something is done about this soon, the Anthracite Region will have a timber resource 50 years from now to soften the economic impact of waning coal supplies.

THE ANTHRACITE REGION'S FOREST LAND

IS NOW



BUT --



HOW FAST WILL FOREST TREES GROW IN THE ANTHRACITE REGION?

This is a very important question to the practicing forester or woodland owner. The answer varies considerably since many factors influence tree growth rates. The most important are: the ability of some species to grow faster than others, effect of site quality on growing capacity, and the vigor, or general health, of individual trees.

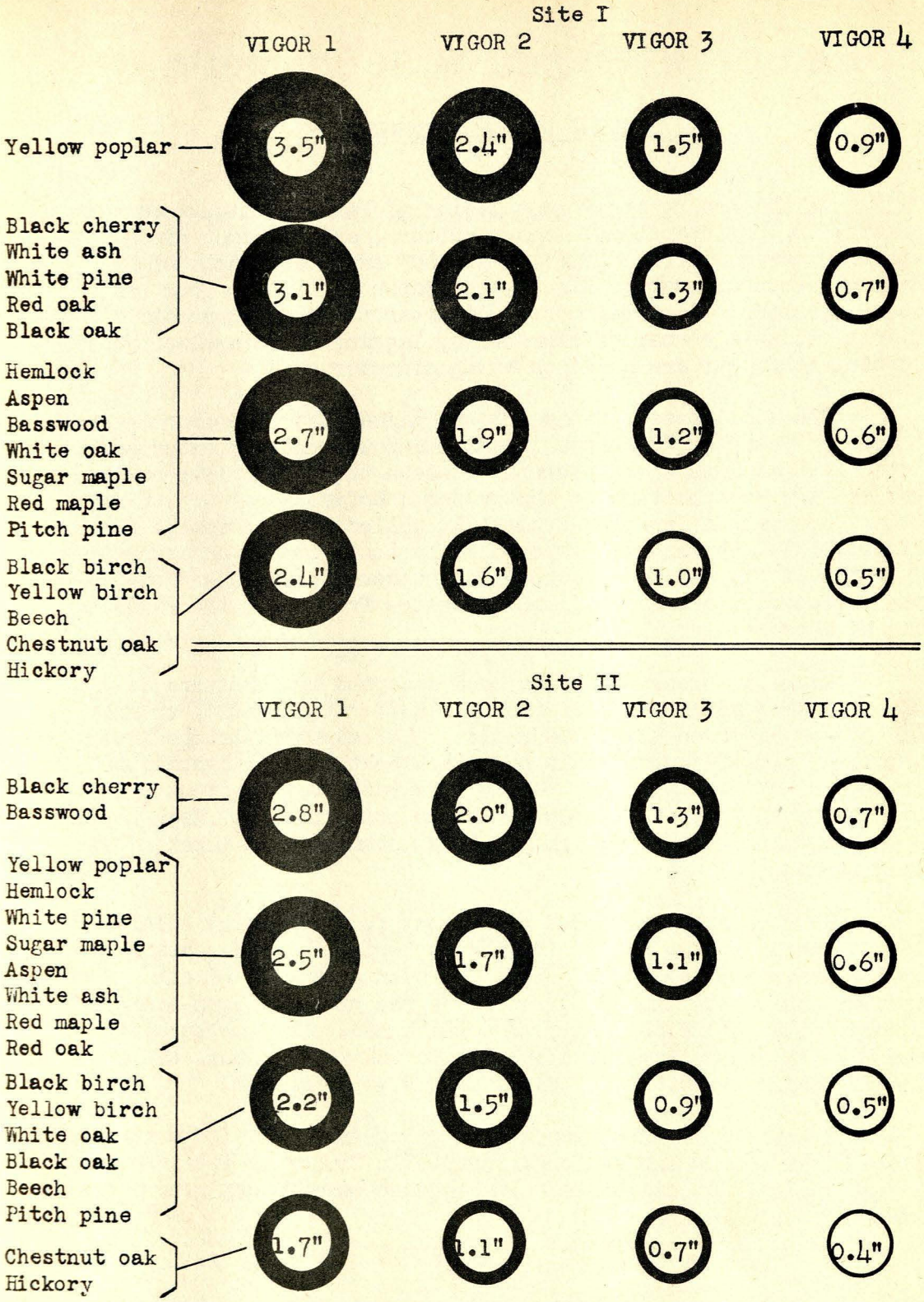
The results of a recent study in the Anthracite Region of Pennsylvania show the relative effects of these three major influences on timber production and growth rates for the major species. Eighteen species were considered. All forest lands on which data were collected were classified into three site classes as determined from physiographical locations, ground moisture supply, and exposures. Individual trees used in the study were put into one of four vigor classifications depending upon size of crown, position of crown as related to those of adjacent trees, and the presence or absence of disease.

A total of 11,000 trees 3.5 inches d.b.h. and over were selected in the counties of northeastern Pennsylvania. All species were represented in a large number of samples on the two best forest sites (I and II) and in all four vigor classes. For each tree the species, vigor class, past 10-year radial growth as measured from an increment core, and site class were recorded. This information was summarized and analyzed to get the effect of forest sites and vigor classes on tree-diameter increment.

What does this mean to the forester or land owner? Maximum volume production can, of course, be expected on the better sites. Other things equal, fast-growing species give promise of highest volume yields over a period of time. Since crowded trees grow slowly, one must thin stands as they become older and severe competition between individual crowns results. In order to keep stands as thrifty as possible, it is important that crop trees be permitted to grow free of this competition and to maintain either vigor 2 or 1 growth rates.

Further study is needed to determine which species will and will not respond to release and how long a period of time after cutting is required before a change in vigor class occurs.

HOW SITE AND VIGOR AFFECT GROWTH IN THE ANTHRACITE REGION
10-year growth (in inches) inside bark, at breast height:



IS STUMP DIAMETER IMPORTANT?

In the Anthracite Forest Region of Pennsylvania, woodland owners, logging operators, timber cutters, and woodsmen often speak in terms of tree diameters as they exist at stump height. Many mine-prop operators figure the content of a tree from its stump diameter. A certain stump diameter to them represents a fairly reliable number of mine-props, lagging or forepoles. Most cutting contracts are based on stump diameter.

The accelerated cutting of saw-timber and mine-prop material in recent years has resulted in many disputes between owner and cutter. Sometimes these disputes concern the reliability of the volume figures submitted by the cutter. Before legal action is taken, however, a forester is usually called upon to settle the dispute. It becomes his responsibility to arrive at an accurate estimate of the volume removed. The number of stumps and their diameters are the only available evidence from which the estimate can be made.

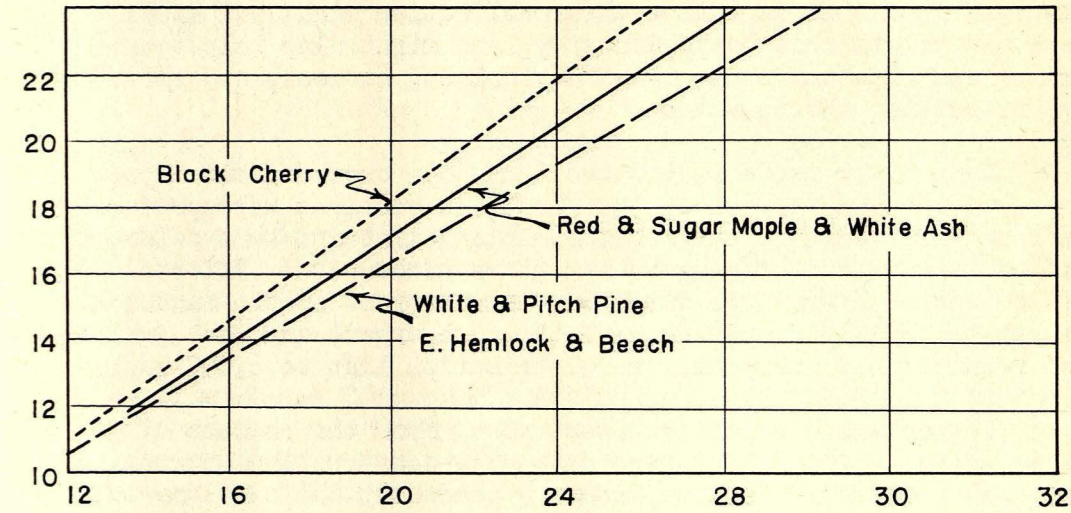
Diameter-breast-high has been accepted by foresters as the more reliable measurement of tree volumes. As a result, volume tables are based on this measurement. Yet stump diameters have a practical significance. This necessitates the determination of stump-d.b.h. relationships. Since this ratio varies from region to region, bne set of figures cannot be standardized. Each region becomes an individual problem and local stump-d.b.h. tapers must be determined.

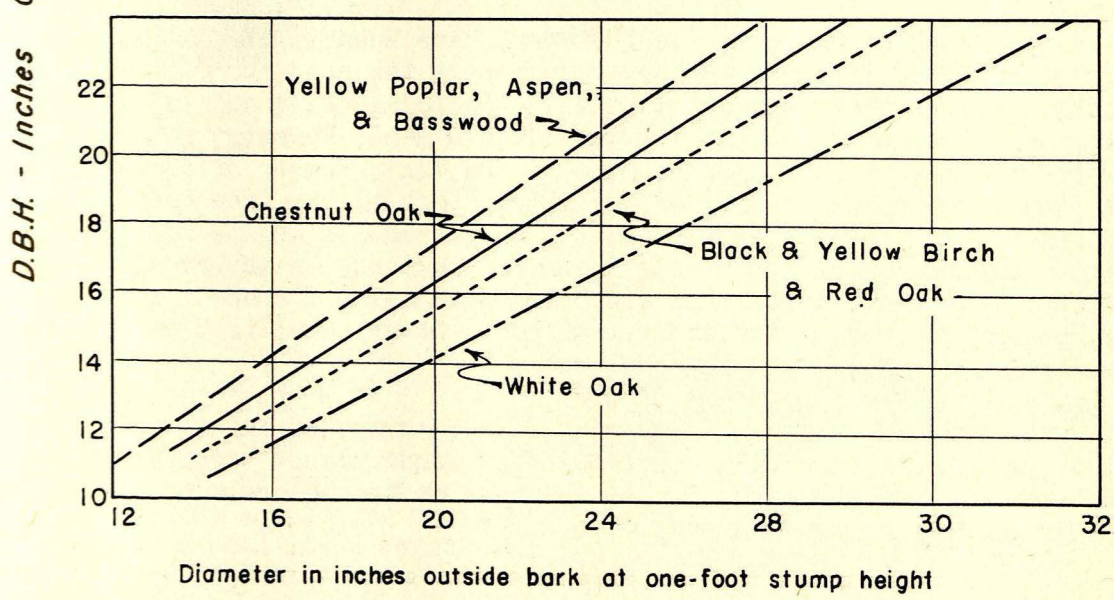
This relation has been worked out for commercial species found growing in the Anthracite Forest Region. Since certain species have similar tapers they have been grouped. Of all species, white oak has the greatest degree of taper from stump to breast height; black cherry has the least. For instance, in the 22-inch stump diameter class, white oak has a d.b.h. of 16 inches, while the d.b.h. of black cherry is 20 inches.

While this information was compiled primarily for use with "Site Class Volume Tables for Merchantable Timber in the Anthracite Forest Region," it can be used in conjunction with any good volume table for this region.

RELATION OF STUMP DIAMETER TO D.B.H.

For Merchantable Timber in the Anthracite Region of Pennsylvania





THE LOGGERS' HANDBOOK

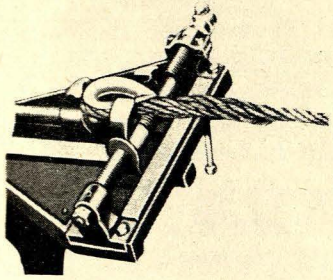
During the past year and a half the Station has been putting out, section by section, a preliminary review edition of a "Northeastern Loggers' Handbook." The purpose of the handbook is to present, in simple, easy-to-read language, the best of the old and new methods for doing the logging job in this part of the country. It was hoped that such a publication might help to attract new men to this basic industry, and might also help to teach them — and old-timers, too — the simplest, easiest, and safest ways of getting the work done.

Demand for these review sections has exceeded all expectations. A thousand copies of the first few sections were produced, and these were sent to our regular mailing list and to a selected list of loggers and logging-equipment manufacturers. Efforts were made to keep the mailing list down, but interest in the handbook was great. Merely complying with the most urgent and best justified requests has increased the distribution list to 6,000 copies.

Comments and criticisms were asked from the readers of these review sections, and some extremely constructive suggestions have been received. One pulp company sends out the sections to several of its field men, and collects and forwards their comments. Several equipment manufacturers have sent in additional pointers on the use of their tools, and information about new equipment being designed or manufactured. As a result of such comments several sections have been revised, and other revisions are in process.

The bulk of the comments, however, have been merely laudatory or requests for more copies. Apparently the need for such a handbook was greater than anticipated. Public agencies and private companies wanted copies for their field men. Forestry schools wanted copies for their faculty members and, in a number of cases, for their students. Because of the safety tips given, insurance companies asked for copies for their loss-prevention engineers. Pulp companies wanted copies for their contractors. A number of pulp and lumber companies that are holding training courses for war veterans wanted copies for their trainees. Other requests have come from individual farmers and loggers.

To date 12 sections on logging have been issued and 4 more are in process. These will constitute the woodcutters' portion of the handbook. In addition, 5 or 6 sections on the supervisory aspects of logging are planned.

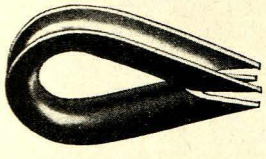


STEP 4

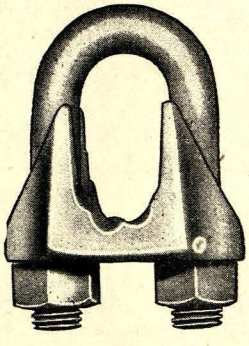
Finally, apply seizing wire to the entire splice so it will not cut the hands of the men who will handle the rope. Loosely spiral 6 or 8 inches of soft wire down around the splice from the point of the thimble; then wind it back up over the splice, tightly and uniformly, to the point of the thimble. Twist together the two ends and tap them with a mallet so they lie close to the rope.

A splice made in this manner should develop 80 to 90% of the strength of the original rope in the sizes used in the Northeast. The first splices you make may look a little ragged; but they will be about as strong as a smoother job.

The clips and knots so frequently used by Northeastern loggers do not develop anywhere near the strength of the spliced eye. Clips should be used on live lines only as an emergency measure. They are bulky and will not go through the fairlead or sheaves properly; they are difficult to handle; and they are a continual cause of accidents. The use of clips should be confined to guy lines and other stationary cables.

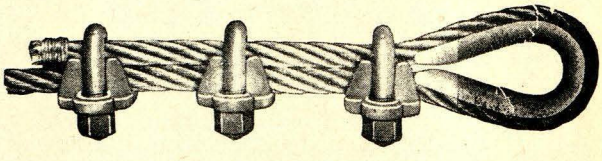


THIMBLE



CLIP

When you use clips, make sure that the base of the clip is applied to the live end of the rope, and the U-bolt to the dead end. If the clips are put on opposite sides, or staggered, the loaded rope will be deformed, and its strength will be reduced.



CORRECTLY APPLIED

FIELD COURSES IN KILN DRYING

Lumber-yard inventories dropped to a new low during the war period. Stocks on hand and in the process of air seasoning at saw mills, wholesale and retail yards, and wood-working plants were drawn upon heavily to fill our wartime lumber needs. Lumber users could not wait for it to air season -- even though many plants and construction jobs require thoroughly air-seasoned or kiln-dried lumber. Thus the supply of lumber in the process of air seasoning diminished rapidly; at present it is still meagre but increasing.

This critical shortage of dry lumber has increased the demand for new kilns. The Northeast's existing kiln capacity is inadequate since more than half of the lumber produced is never kiln dried. To meet this shortage, many industries expanded kiln-drying facilities. Other concerns that normally purchased dry lumber ordered kilns. The pressure for dry lumber has also made plants realize the need for improving kiln performance both in quality and quantity. From the industry came requests for dry-kiln information, and for kiln-drying courses such as those formerly taught at the Forest Products Laboratory. In cooperation with the Laboratory, our Forest Utilization Service arranged for a field course in kiln drying.

The first field course in kiln drying in the Northeast was held at Old Town, Maine, under the sponsorship of the Forestry Department of the University of Maine. Nineteen men from the wood-working industry -- including both kiln operators and management representatives -- and six forestry students were enrolled for the two weeks of instruction. The Forest Products Laboratory provided the instructors: men who have conducted research on kiln-drying problems and who certified and inspected all types of kilns during the war. They brought to the course a great amount of practical information.

Both the operation and the design of dry kilns was discussed in the kiln course. A partial list of the lectures included: types of kilns; kiln design, modification, and construction; how wood dries, and variations among species; functions of heat, circulation, and humidity and their control for rapid, uniform drying; drying schedules for different species; air-seasoning problems; and methods of detecting kiln faults.

The men taking the course had an opportunity to gain some kiln-operating experience and to observe four types of kilns in use at one of the commercial plants in Old Town. Each student had an opportunity to discuss his own seasoning problems with the instructors. Many of those who attended have already put into practice ideas they obtained from the instruction, and have been able to improve both the speed of drying and the efficiency of their kiln equipment.

KILN SCHEDULES TO AID THE WOOD TURNING INDUSTRY

Most of the turned products and novelties made in this country are produced by about 500 mills in the Northeast. As end products have changed, the industry has been forced to apply its ingenuity to new methods of production. Often improvements have been limited to new or modified machinery for turning while air-seasoning and kiln-drying practices have remained about the same.

A need for improvements in air-seasoning and kiln-drying methods has been shown through investigations made by our Forest Utilization Service, in cooperation with the Forest Products Laboratory. Wood-turning plants in New England saw mostly 4-foot bolts into squares. These squares or bars range from 3/8 to 3-1/2 inches, with few exceptions. Kiln drying 1-inch squares is simple compared to drying 4/4 lumber. The lumber industry has had drying schedules for years, yet the turning industry has no schedules for kiln drying squares.

To determine drying schedules for squares, we obtained the cooperation of a plant suitable for making experimental runs: the Stowell-MacGregor Corporation at Dixfield, Maine. A small kiln equipped for these purposes was provided by the Laboratory and installed at the plant. Actual runs were made by a representative of the Laboratory.

Two requirements had to be considered in kiln drying white birch: (1) a schedule for whiteness desired by manufacturers of products in which color is important; and (2) a schedule to get speed in drying without defects. The color requirement is important in products that demand high-quality white wood. The problem: air-seasoned white birch dries white; but green summer-cut birch darkens during kiln drying because of oxidation and other chemical changes in the sap materials. In enameled and cheaper products the color of the wood is not important.

To set up the schedules, maximum temperatures at the lowest humidities had to be determined. This was done by trying schedules until one was found that was within the safety limits. After a schedule was determined in the laboratory kiln, it was proven in the plant's forced-circulation commercial kiln.

In the small Laboratory fan kiln, 1½-inch white birch squares were dried to the moisture content desired for spools in 36 hours. White birch dries easily without defects. With proper temperatures, circulation, and venting capacity this short drying time can be duplicated in commercial kilns.

The schedules developed in the test runs at Dixfield will be published and distributed as soon as possible. Meanwhile we plan to continue kiln-drying and air-seasoning studies.

OUR AILING CHARCOAL INDUSTRY

Although the demand for and the price of charcoal are at an all-time high, the wood-distillation industry in the Northeast is probably at its all-time low. Of more than 40 wood-distillation plants that once dotted the New York-Pennsylvania area, only 11 are still in operation. The largest of these convert only 60 cords of wood a day, in contrast to the 120-cord-a-day plants that formerly operated.

The wood-carbonization industry's output is urgently needed for products used in the manufacture of metals, paints, dyes, foodstuffs, and filters, and as fuel for cooking and domestic heating. It also provides an ideal outlet for low-grade material that should be removed from our hardwood stands in thinnings and improvement cuttings. Yet the industry is critically ill.

The reasons for the low state of the industry are too many to list here. Some of the most important are: (1) synthetic methanol and acetic acid provide stiff competition for the methanol and acetic acid produced as charcoal byproducts; (2) wood-carbonization plants have relied on low-paid labor; and (3) the small Northeastern plants have been established a long time, and much of their equipment is worn out, inefficient, or out-of-date.

Many problems must be solved to bring the wood-carbonization industry back to health. Our Forest Utilization Service has been looking for answers to these problems. One answer is mechanization -- from woods work through the plant operations. The Station has helped several plants to take steps in this direction.

One promising development is in tree-length logging, and bucking or clipping the wood into short lengths at the roadside or at the plant. Short lengths -- 12 to 15 inches -- can be handled mechanically by conveyors. It has been found that just as much wood can be piled in a retort buggy by quick rough-and-tumble loading of short lengths as by careful hand-piling of 52-inch sticks. Moreover, short lengths dry and carbonize quicker and better without splitting. Another development is the use of predriers using waste stack-gases; these can dry the wood in 2 or 3 days to as low a moisture content as air drying would bring it in 18 months.

Two methods of plant operation are being studied. The first intensifies the recovery processes to get a greater variety of more highly refined byproducts. The second method does not bother with byproducts; it uses the wood gases for combustion only, to dry the wood and carry it through the carbonization. Northeastern plants prefer the second method because it requires a smaller initial investment, and it makes charcoal manufacture possible in regions where fuels such as coal or natural gas are expensive. It also concentrates on a product which has no marketing problem.

FIRE CAN BE A TOOL

A new silvicultural method that uses controlled winter burning has possibilities in helping to rehabilitate South Jersey's upland oak-pine stands at low cost. The new method developed at the Lebanon Experimental Forest, reclaims these poor forest stands at an indicated cost of $4 per acre. Comparable results by mechanical methods cost from $20 to $26 per acre. In addition, the controlled burning makes the treated area more resistant to wild fire. Enough information has been obtained so that New Jersey state forestry officials are now testing this method on a larger scale on state forest lands.

New Jersey's pine region has long presented a baffling problem: how to convert the low-value hardwoods and pines into good productive forest lands? Logging and uncontrolled fires have left these forests in poor condition. Fires, which take a large annual toll, have reduced the pine-oak forests to damaged pine sprouts and worthless scrub oak.

Previous attempts to reclaim these forest stands have been made either by planting or by preparing the soil for natural seeding. This required heavy machinery, at an initial cost of about $15 to $20 per acre. Later, two cleanings were needed to get rid of hardwood sprouts, and these cost about $3 per acre each. This method brought about a good mixed stand of trees, but it did not reduce the danger of fire.

Under the new method, the forest stand is subjected to from one to three controlled winter burnings. These reduce the litter on the ground, which prepares a seedbed for pine. Hardwood sprouts are controlled by one cleaning operation with the axe. When the pine seedlings are over 2 inches in diameter they can withstand more controlled winter burning; but most of the small oak sprouts are killed back. This results in a high percentage of pine in mixture with hardwoods. The stand receives light burning treatments thereafter at approximately 5-year intervals. Ground litter is kept so reduced that wild, damaging fire is no longer a menace. Total indicated cost of these measures to raise a good stand of merchantable trees: $4 per acre.

The protection value of this new method recently was demonstrated dramatically. A fire sweeping over private lands toward the Lebanon Experimental Forest stopped cold when it reached the line where controlled winter burns had been used to reduce surface fuels.

These findings are from cooperative studies by the Northeastern Station and the Forestry Division of the State Department of Conservation. The experiments have been running for 10 years. The State Game Commissioners are particularly interested in the results: the controlled fires favor herbaceous growth on the forest floor, and this favors quail.

WHY GRADE HARDWOOD LOGS?

The Otsego Forest Products Cooperative Association in Cooperstown, New York, uses an assortment of hardwood logs. These logs are obtained mostly from farmer members and are sawn into lumber. When these logs are delivered at the mill, they are graded and scaled with the Doyle log rule. Log grading was established to assure the members that they would be credited with approximately the true value of their logs. The log-grading rules were initially set up by the Forest Products Laboratory, Madison, Wisconsin, and were modified from experience. They are based on the lumber yields that can be expected from logs meeting various specifications. Logs are divided into four grades: Select, No. 1, No. 2, and No. 3. These grades depend on differences in length, minimum diameter, crook, knots, and other defects.

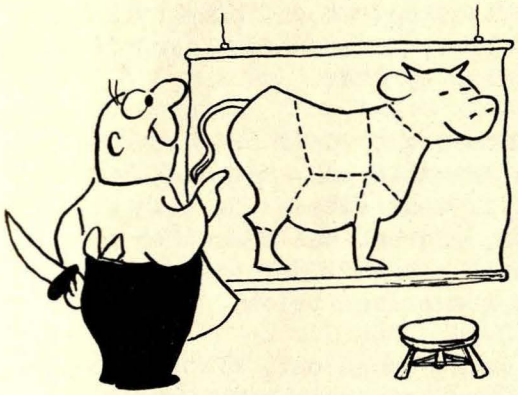
In order to clarify the relationship between log grades and lumber values, a special study was made at Cooperstown with 170 thousand board feet of maple, oak, beech, basswood, birch, and other hardwood logs. The lumber sawn from these logs was also graded and was compared with the log grades, with the following results:

Log grade	Distribution of lumber by grade	
	First and Second and Select	No.1, No.2, and No.3 Common
	Percent	Percent
Select	64	36
No. 1	48	52
No. 2	22	78
No. 3	11	89
Average	47	53

The principal conclusions from this study applicable to hardwoods may be summarized as follows:

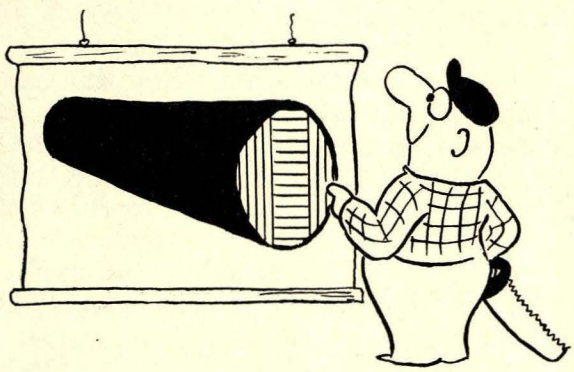
Log grading enables the sawmill operator to know what he is buying, and the woodland owner to know the value of what he is selling. Log grading can be an incentive for the woodland owner to manage his woodland so that it will produce the greatest possible number of high-grade sawlogs.

TENDERLOIN OR BALONEY ?



A butcher can tell, even before he kills a beef, whether he has an animal that will yield high-grade tender meat -- or just another "baloney cow."

With log grading, a sawmill operator can tell whether his logs will yield high-grade clear lumber -- or knotty 2 x 4's .....



.... and the woodland owner will get the true value of his timber.

EFFECT OF BROWSING BY DEER AND RABBITS

In the second-growth northern hardwood forests of northwestern Pennsylvania the undergrowth is often very sparse. Tree seedlings are lacking, and shrubby and herbaceous vegetation on the forest floor is scarce. Several factors have been thought responsible for this: lack of sufficient light, intense root competition, lack of viable tree seeds, and browsing by deer.

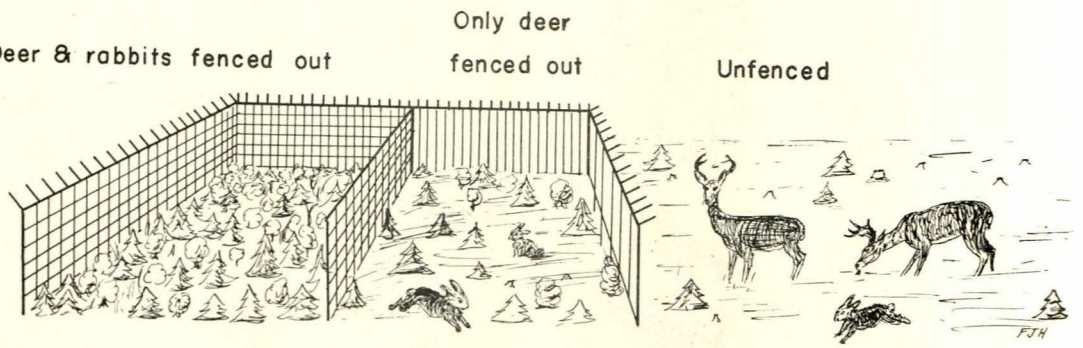
To determine the effect of browsing by deer and other animals, a study (1936-46) was made in the Allegheny National Forest. A series of plots were fenced, on different sites. On each site one plot was fenced to keep out deer, another was fenced to keep out both deer and rabbits, and a third was left unfenced. Results from a typical lower slope site are summarized below.

Where both deer and rabbits were fenced out, tree reproduction almost tripled in 10 years. Where only deer were fenced out, there was a slight drop in tree reproduction. Where both animals were allowed to browse freely, only about half the tree seedlings were left after 10 years. Rabbits nipped off terminal shoots, but seldom gnawed or girdled. They liked red maple, but didn't care much for hemlock.

We can't afford to fence all our forest land. The problem is to develop enough seedlings and shrubs both to provide food for wildlife and to still have enough left for good future forest stands.

In 1936 there were 700 seedlings per acre.

Here's what happened:



In 1946

Deer & rabbits fenced out	Only deer fenced out	Unfenced
2000 seedlings per acre	623 seedlings per acre	322 seedlings per acre

MORE PULP FROM HARDWOODS

A greater use of hardwoods by the pulp and paper industry is fast becoming a "must" in the Northeast — particularly in New England and New York. Spruce and balsam fir, the preferred pulpwood species, have been seriously over-cut (estimated annual growth, 1.4 million cords; cut in 1944, 1.8 million cords). Even this over-cutting does not provide the 3.5 million cords the mills need. The gap has been filled normally by pulpwood imports from Canada. However, the pulpwood forests of eastern Canada are now in the throes of the worst budworm epidemic ever experienced; millions of cords of spruce and fir timber have been killed. Meanwhile, Canada's own pulpwood requirements have been expanding rapidly. The outlook for softwood raw materials for the Northeast's pulp and paper industry is gloomy.

Efforts to increase the growth of spruce and fir are needed; but these should be supplemented by an expanded use of hardwood pulpwood. There is a surplus of such material, and failure to remove it from the land has often led to the suppression of the softwood species.

In February and March, 1946, the Station brought two pulp-and-paper technicians from the Forest Products Laboratory to the Northeast. With a member of our Forest Utilization Service, they visited about 25 typical pulp mills. With officials of these mills they discussed problems of increasing the use of hardwoods, including logging and wood handling, pulp and paper making, and qualities and usefulness of products made from hardwood pulps. A number of specific problems were encountered.

To help meet these problems the Laboratory undertook further work on the pulping of typical Northeastern species by the groundwood, sulfate, and neutral sulfite semichemical processes. Two Northeastern companies are sending technicians to Madison to work with the Laboratory staff on specific problems. Many companies have gone ahead with studies of their individual problems in the greater use of hardwoods. Some are experimenting with grinding; some with the sulfite process; and others with the small-scale manufacture of semichemical pulp.

The Station is trying to help, especially in logging methods and equipment. Some of the problems: Hardwoods are heavier and are apt to be more crooked and in shorter lengths than softwood. They are more expensive to log and to handle at the mill. Some of the advantages: Higher yields of pulp from hardwoods are possible. Also, through integrated logging, high-quality logs and bolts can be sold at higher prices for special purposes, and this way the cost of pulpwood delivered to the mill can be reduced.

A report on the results of these efforts will be put out by the Station in the coming year. Work on the problem will continue.

HOW PULPWOOD CUTTINGS AFFECT OUTPUT AND GROWTH

How do second-growth hardwood stands respond in growth after various degrees of pulpwood cuttings? A partial answer is provided by a study started 6 years ago in the northern Allegheny Plateau region in cooperation with the Armstrong Forest Company.

In 1940, 18 plots ranging in size from .5 to 1.0 acre were established in Elk County, Pa., in a 43-year-old stand of black cherry, sugar and red maple, and beech. In each set of six plots, one was cut to a 5-inch d.b.h. limit, one to 8 inches, and one to 11 inches.

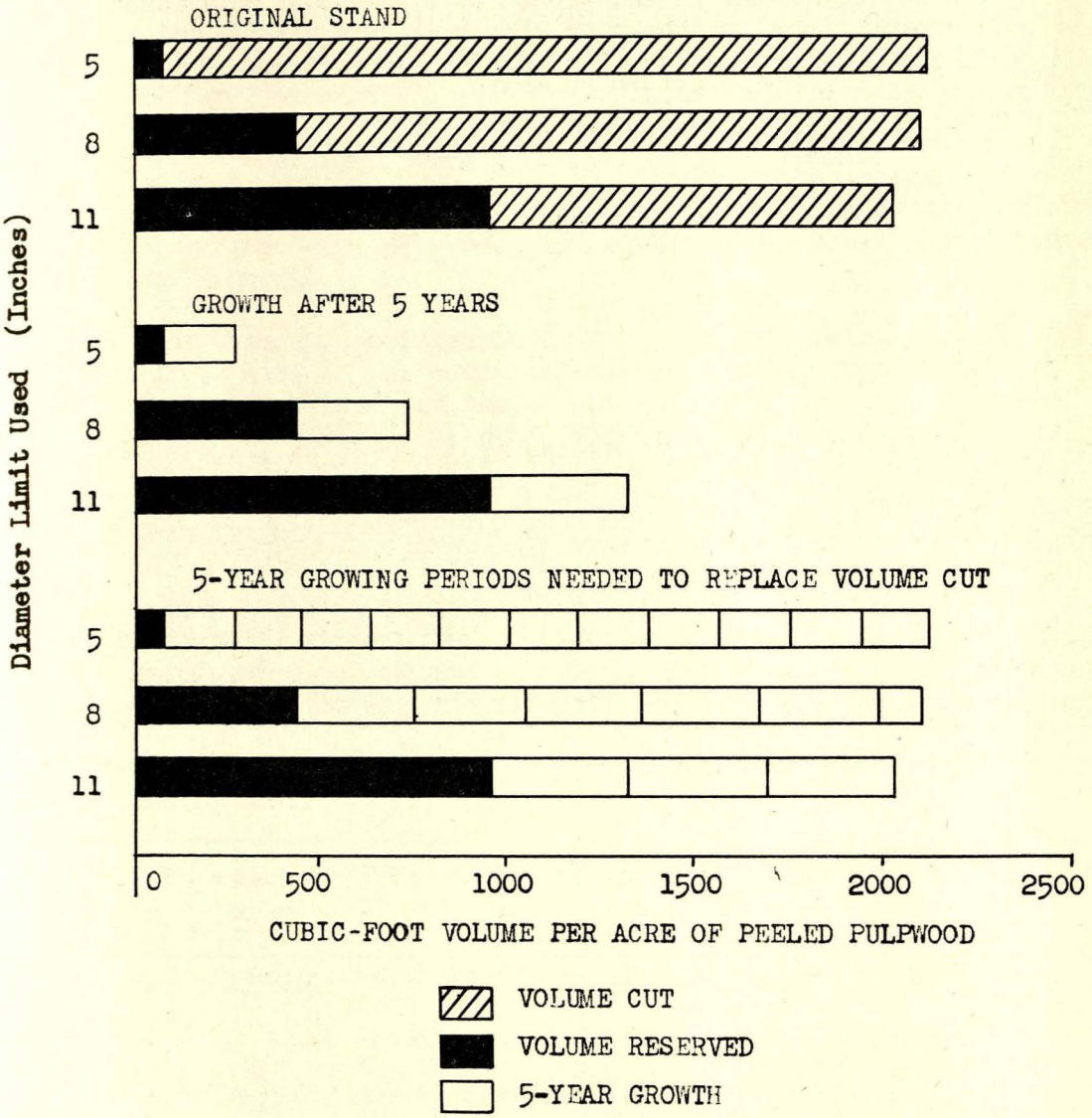
Time records of these cuttings showed that 1.9 times more solid wood can be cut per day from trees 11 inches and larger than from trees 5 to 8 inches in diameter. When the smaller trees were cut, the earnings of the woodcutter dropped, and the cost of pulpwood to the company rose 18 percent because the stacks of smaller wood contained less volume than those of larger bolts.

Remeasurements of these plots made in the spring of 1945 indicate that the cutting to an 11-inch d.b.h. limit results in better growth. Heavy cutting to a 5-inch limit leaves a very small growing stock (mostly scattered hemlock hold-overs not cut for pulpwood); and the increase is mainly from ingrowth of small trees. This growth totals 260 percent of the residual stand, but it actually amounts to only 38 cubic feet per acre per year. Growth after an 8-inch limit cutting was 62 cubic feet per acre per year; and after the 11-inch cutting, 74 cubic feet.

The length of time required to replace the volume cut also reflects the advantages of the 11-inch limit. Where the 5-inch cutting limit was used, it will take 55 years to replace the original volume; for the 8-inch cutting, 27 years; and for the 11-inch cutting, 14.5 years. In terms of 5-year growing periods, the 5-inch cutting needs 11 periods; the 8-inch, 5½ periods; and the 11-inch, less than 3 periods. This estimate is based on the conservative rate of growth during the first 5 years after cutting. Any increase in growing rate would probably affect all the plots, and the ratio would not be expected to change.

Other studies of partial cutting on second-growth hardwood stands similar to the above show that the best-formed and most vigorous trees should be left; and not more than 40 percent of the volume of less desirable trees should be cut to thin the stand. This treatment gives even better results in future growth than the use of a strict 11-inch d.b.h. limit alone.

CUTTING TO 11-INCH DIAMETER LIMIT RESULTS IN BETTER GROWTH



TOBACCO POLES AND HIGHWAY POSTS FROM RED PINE THINNINGS

For many years red (Norway) pine has been one of the more popular species for planting in the Northeast. It is estimated that in Connecticut alone 25,000 acres of red pine plantations have been established in the last 40 years.

At a certain point in the growth of a red pine plantation the tree crowns close in, the rate of growth slows down, and thinning is needed. The tree age when this occurs depends on the original spacing of the trees:

Space between trees (feet)	Tree age when crowns close in (years)
4 x 4	15 - 18
6 x 6	18 - 20
8 x 8	20 - 22
10 x 10	23 - 25

During the past 30 years, for one reason or another, many of the Connecticut plantations have passed the point when the first thinnings should have been made. As a result, current growth rates are below what could be expected under good management.

There are several possible markets for red pine thinnings. The best seem to be tobacco poles (12½ feet long to a 5-inch tip) and highway posts (7½ feet long to a 7-inch tip). Several red pine plantations were measured to determine the potential yield:

Age	Spacing	Trees per acre	Average d.b.h.	Average height	Yield per acre1/	
					Tobacco poles	Highway posts
Years	Feet	Number	Inches	Feet	Number	Number
15	4 x 4	1,250	3.9	15	—	—
30	4 x 4	1,211	5.8	50	358	132
35	6 x 6	825	6.8	45	348	2/40
23	8 x 8	583	7.2	38	497	416
31	10 x 10	496	8.1	40	468	456

1/ Based on clear-cutting.

2/ Poor site.

Further studies are needed to determine whether or not tobacco poles and highway posts can be produced at a profit. Since tobacco poles cannot be treated with creosote because of a bad effect on tobacco, they may be relatively short-lived unless other treating methods are developed. Even so, it appears that red pine thinnings can pay their own way in Connecticut -- and pay dividends in future yields of sawlogs.

DON'T SAVE LOW-VIGOR TREES

Where balsam fir trees are reserved as growing stock, only the most vigorous and promising trees should be kept. Remove as many low-vigor, poor-risk trees as practical if you want a good growth rate.

Partial-cuttings in a series of spruce-fir plots on the Gale River Experimental Forest in New Hampshire show the value of removing low-vigor trees. These plots were partially cut in 1940, and recently were re-measured. Examination showed that Plot I, which had the least growing stock (77 square feet of basal area), had the best growth. Plot II, with a little more growing stock (87 square feet, basal area), showed a net loss. Plot III, which had the largest growing stock (139 square feet, basal area), had a very small growth.

Why these inconsistencies? Further examination gave the answer. It lies in the character of the growing stock reserved. Plot I had 209 balsam fir trees, but they were healthy, vigorous specimens. The growth was good, and only 6 square feet of basal area were lost through death. Plot II had only about half as many balsam fir, but many of these were mature and large. They had quit growing, and many died. This offset the growth of the spruce. Plot III had the most balsam fir, but they were small and mostly of fair vigor. The stand was dense, having been cut lightly and growth was only moderate.

These preliminary results indicate that it isn't only the amount of growing stock left, but also the quality of the trees in the reserved stand that counts.

Growth and mortality after partial-cutting in spruce-fir stands

Plot number	Growing stock retained			Mortality, in basal area		Net increment in basal area	
	Basal area	Red spruce	Balsam fir	Red spruce	Balsam fir		
	Square feet	Number	Number	Square feet	Square feet	Square feet	Percent
I	77.0	92	209	1.9	6.2	22.7	4.9
II	86.6	151	118	2.2	16.0	-5.9	-1.1
III	138.6	166	387	0.1	12.5	11.4	1.4

PUBLICATIONS

by members of the staff

Jan. 1, 1945 - Dec. 31, 1946

IN PRINT

Bratton, Allen W.
Another spray gun. Jour. Forestry 44 (3) : 206. 1946.

..... and Ferguson, R. H.
Use of the spray gun in marking timber. Jour. Forestry 43 (2) : 113-117. 1945.

Cunningham, F. E., and Ferguson, R. H.
Cost of producing hardwood ties in Connecticut. Jour. Forestry 44 (9) : 668-672. 1946.

Division of Forest Economics
Forest area in Pennsylvania. (In cooperation with Commonwealth of Pennsylvania.) Pa. Dept. Forests and Waters. Cir. 35. 64 pp. Harrisburg. 1944.

Division of Forest Management
Guide for cutting loblolly pine of the Eastern Shore. AIS-2, U.S. Dept. Agr. 1945.

.....
Guide for cutting Allegheny northern hardwoods. AIS-3, U.S. Dept. Agr. 1945.

.....
Guide for cutting New England northern hardwoods. AIS-4, U.S. Dept. Agr. 1945.

.....
Guide for cutting oak forests. AIS-5, U.S. Dept. Agr. 1945.

.....
Guide for cutting red spruce. AIS-6, U.S. Dept. Agr. 1945.

.....
Guide for cutting eastern white pine. AIS-7, U.S. Dept. Agr. 1945.

Ferree, Miles
The pole caliper. Jour. Forestry 44 (8) : 594. 1946.

Harper, V. L.
Research in management and utilization of forests in Pennsylvania. Pa. Forestry Assoc. Forest Leaves 36 (1) : 7-8. 1946.

.....
Hardwood pulp resources of the Northeast. New Developments in Hardwood Pulp. Northeastern Wood Utilization Council. New Haven, Conn. October 1946.

.....
Timber resources of New England and New York with special reference to pulpwood supplies. The Paper Industry and Paper World. December 1946.

..... and Rettie, James C.
The management status of forest lands in the United States. Report 3 from a reappraisal of the forest situation. U.S. Forest Service. Washington. December 1946.

Hough, A. F.
Frost pocket and other microclimates in forests of the Northern Allegheny Plateau. Ecology 26 (3) : 235-250. 1945.

..... and Taylor, R. F.
Response of Allegheny northern hardwoods to partial cutting. Jour. Forestry 44 (1) : 30-38. 1946.

Little, S.
Influence of fuel types on fire danger. Jour. Forestry 43 (10) : 744-749. 1945.

..... and Moore, E. B.
Controlled burning in South Jersey's oak-pine stands. Jour. Forestry 43 (7) : 499-506. 1945.

Maki, T. E., and Marshall, H.
Effects of soaking with indolebutyric acid on root development and survival of tree seedlings. Bot. Gaz. 107 (2) : 268-276. 1945.

..... and Marshall, H.
Transpiration of pine seedlings as influenced by foliage coatings. Plant Physiology 21 (1) : 95-101. 1946.

....., Marshall, H., and Ostrom, C. E.
Effects of naphthaleneacetic acid sprays on the development and drought resistance of pine seedlings. Bot. Gaz. 107 (3) : 297-312. 1946.

..... and Way, R. D.
Effects of pre-storage treatment of hardwood and pine seedlings with a-naphthaleneacetic acid. Bot. Gaz. 108 (2) : 219-232. 1946.

McQuilkin, W. E.
Use of mulch, fertilizer, and large stock in planting clay sites. Jour. Forestry 44 (1) : 28-29. 1946.

.....
Hormones and trees: Another phony report. Jour. Forestry 44 (7) : 523-524. 1946.

.....
Tests of direct seeding with pines in the Piedmont region. Jour. Agr. Res. 73 : 113-136. 1946.

..... and Showalter, J. W.
Lanolin mixtures as dressings for tree wounds. Arborists News 10 : 17-19. 1945.

Nofziger, Ed.
Two Trees. Printed by American Tree Association, Washington; distributed by U.S. Forest Serv., Philadelphia, Pa. 1945.

Ostrom, C. E.
Effects of plant-growth regulators on shoot development and field survival of forest-tree seedlings. Bot. Gaz. 107 (2) : 139-183. 1945.

Rettie, James C., and Hallauer, Frank J.
Potential requirements for timber products in the United States. Report 2 from a reappraisal of the forest situation. U.S. Forest Service. Washington. December 1946.

Schreiner, E. J.
How sod affects establishment of hybrid poplar plantations. Jour. Forestry 43 (6) : 412-427. 1945.

.....
Variation between two hybrid poplars in susceptibility to the inhibiting effect of grass and weeds. Jour. Forestry 43 (9) : 669-672. 1945.

.....
Review of Cinchona in Java: The Story of Quinine by Norman Taylor. Jour. Forestry 44 (2) : 139-40. 1946.

.....
Review of science and scientists in the Netherlands Indies. Jour. Forestry 44 (7) : 537-538. 1946.

Shirley, H. S.
Light as an ecological factor and its measurement. Bot. Rev. 11 (9) : 497-532. 1945.

Simmons, Fred C.
Methods of loading lumber at the rear of small sawmills. Canada Lumberman 65 (23) : 39-40, 80. 1945.

.....
How to choose and sharpen a crosscut saw. South. Lumberman 173 (2169) : 68-69, 72, 74. 1946.

.....
Skidding with tractors. South. Lumberman 173 (2173) : 72, 74, 76, 78, 80, 82. 1946.

.....
Limbing and bucking the tree. South. Lumberman 173 (2175) : 68, 70, 71, 74. 1946.

.....
How to select and take care of your bow saw. South. Lumberman 173 (2177) : 278, 280, 284. 1946.

.....
Some pointers on power saws for logging. Wood 1 (1) : 18-19, 41, 42, 43. 1946.

Spaulding, Perley, and Bratton, Allen W.
Decay following glaze storm damage in woodlands of Central New York. Jour. Forestry 44 (7) : 515-519. 1946.

Taylor, R. F.
A comparison of silvicultural marking and cutting practice rules in a northern hardwood stand. Jour. Forestry 44 (1) : 41-46. 1946.

Westveld, M.
Budworm resistant cutting methods. Forest Insect Investigations 1 (3) : 3. Ottawa, Canada. 1945.

.....
Silvicultural problems of eastern Canada's pulpwood forests as viewed by an American forester. Pulp and Paper Magazine of Canada. April 1945.

.....
Forest Management as a means of controlling the spruce budworm. Jour. Forestry 44 (11) : 949-953. 1946.

SUBMITTED

Bratton, Allen W., Ineson, Frank A., and Robinson, Donald F.
A forest cooperative--and what woodland owners think of it. To be submitted to U.S. Dept. of Agr., Washington, for publication.

Harper, V. L.
Timber resources of New England and New York with special reference to pulpwood supplies. Submitted to Technical Association of the Pulp and Paper Industry, for publication of the proceedings of TAPPI meeting, September 1946.

Ineson, Frank A., Ferree, Miles J., and Robinson, Donald F.
The anthracite forest region--a problem area. Submitted to U.S. Dept. of Agr., Washington, for publication.

McQuilkin, W. E.
Direct seeding of trees. Submitted for publication in U.S.D.A. Yearbook, Washington.

Schreiner, E. J.
Tree breeding for desirable qualities and disease resistance. Submitted for publication in Proceedings of the 22nd National Shade Tree Conference, August 1946.

PROCESSED

Bratton, Allen W.
Hardwood--the bigger, the better; hemlocks--just get bigger. Forest Economics Note No. 2, Northeast. Forest Expt. Sta. November 1946.

Burnham, C. F., Ferree, M. J., and Cunningham, F. E.
Site class volume tables for merchantable timber in the anthracite region of Pennsylvania. Forest Management Paper No. 3, Northeast. Forest Expt. Sta. June 1946.

Carter, Roy M.
Recent methods of wood treatment and their possible application in the turning industry. Northeast. Forest Expt. Sta. 7 pp. January 1945.

.....
How to pile turning squares for rapid air seasoning. Forest Products Paper No. 1, Northeast. Forest Expt. Sta. January 1946.

.....
Piling and its effect on drying in natural circulation kilns. Forest Products Paper No. 2, Northeast. Forest Expt. Sta. February 1946.

.....
Principles of design that affect the operation of a natural circulation kiln. Forest Products Paper No. 3, Northeast. Forest Expt. Sta. February 1946.

Division of Forest Economics
Forest area map for Washington County, Vermont. Prepared from aerial photographs; now available in blueline print form (1 inch = 1 mile).

.....
Forest survey field manual for the Northeastern States. Northeast. Forest Expt. Sta. November 1946.

.....
The forest situation in Pike and Monroe counties. Anthracite Survey Paper No. 7, Northeast. Forest Expt. Sta. November 1945.

.....
The forest situation in Dauphin and Lebanon counties. Anthracite Survey Paper No. 8. December 1945.

.....
The forest situation in Schuylkill and Carbon counties. Anthracite Survey Paper No. 9. May 1946.

.....
The forest situation in Wyoming and Sullivan counties. Anthracite Survey Paper No. 10. June 1946.

.....
The forest situation in Northumberland, Columbia, and Montour counties. Anthracite Survey Paper No. 11. June 1946.

.....
The forest situation in Luzerne and Lackawanna counties. Anthracite Survey Paper No. 12. November 1946.

.....
The forest situation in Wayne and Susquehanna counties. Anthracite Survey Paper No. 13. December 1946.

Ferree, Miles J.
Rate of mine prop production increases with size of trees. Forest Economics Note No. 1, Northeast. Forest Expt. Sta. January, 1945.

Hough, A. F.
Improvement of second growth northern hardwoods by cordwood thinnings. Forest Management Note No. 1, Northeast. Forest Expt. Sta. January 1946.

Little, S.
The effects of forest fires on the stand history of New Jersey's pine region. Forest Management Paper No. 2, Northeast. Forest Expt. Sta. February 1946.

McLintock, T. F., and Westveld, M.
Some financial aspects of removal of overmature balsam fir as a budworm control measure. Forest Management Paper No. 1, Northeast. Forest Expt. Sta. June 1946.

Rettie, James C.
Putting fuel sawdust in the customer's basement. Forest Products Note No. 1, Northeast. Forest Expt. Sta. February 1945.

Rogers, Earl
Use of the parallax wedge in measuring tree heights on vertical aerial photographs. Forest Survey Note No. 1, Northeast. Forest Expt. Sta. May 1946.

Schreiner, E. J.
An analysis of cinchona research needs in Guatemala with special reference to cinchona improvement. Office of Foreign Agricultural Relations, Washington. September 1945.

Simmons, Fred C.
Methods of loading lumber at the rear of small sawmills. Forest Products Note No. 2, Northeast. Forest Expt. Sta. August 1945.

.....
Recent developments in logging in the Northeast. Forest Products Paper No. 7, Northeast. Forest Expt. Sta. January 1946.

.....
Northeastern loggers' handbook (preliminary review edition). Northeast. Forest Expt. Sta. 1946.
Section 1 - How to choose and use your ax.
Section 2 - How to choose, use and sharpen a crosscut saw.
Section 3 - How to select and take care of your bow saw.
Section 4 - Wedges and their use in logging....splitting wood.
Section 5 - Peavies, cant hooks and pulp hooks.
Section 6 - Tools for peeling wood.
Section 7 - Some pointers on power saws for logging.
Section 8 - Pointers on felling trees.
Section 9 - Limbing and bucking the tree.
Section 10 - Ground skidding with horses.
Section 11 - Skidding with tractors.
Section 12 - Wire rope and accessories.
Section 14 - Loading

Westveld, M.
A suggested method for rating the vulnerability of spruce-fir stands to budworm attack. Northeast. Forest Expt. Sta. February 1945.

.....
Plan for studying the cost of budworm resistant cutting methods. Northeast. Forest Expt. Sta. May 1945.

.....
The significance of the budworm problem. Northeast. Forest Expt. Sta. April 1946.

NORTHEASTERN FOREST RESEARCH ADVISORY COUNCIL

Francis R. Cope, Jr., Acting Chairman, Woodbourne Orchards, Dimock, Pa.

Victor A. Beede	Head, Dept. of Forestry, Pennsylvania State College, State College, Pa.
Harold O. Cook	Director, Dept. of Conservation, 15 Ashburton Place, Boston, Mass.
Joshua A. Cope	Extension Forester, College of Agriculture, Ithaca, N. Y.
D. B. Demeritt	Dead River Co., 6 State St., Bangor, Maine
E. O. Ehrhart	Forest Engineer, Armstrong Forest Co., Johnsonburg, Pa.
R. Lynn Emerick	Dept. of Forests and Waters, Harrisburg, Pa.
Thomas Farwell	General Manager, Ryegate Paper Co., East Ryegate, Vt.
John R. Foster	State Forester, Forestry and Recreation Dept., Concord, N. H.
George A. Garratt	Dean, School of Forestry, Yale University, New Haven, Conn.
W. G. Howard	Director, Lands and Forests, Conservation Dept., Albany 7, N. Y.
H. A. Hanlon	Cotton and Hanlon Co., Odessa, N. Y.
Curtis M. Hutchins	President, Passamaquoddy Land Co., Bangor, Maine
J. S. Illick	Dean, New York State College of Forestry, Syracuse, N. Y.
Eric G. Jacobson	Chief Forester, Dept. of Agriculture and Conservation, State House, Providence, R. I.
E. O. Jennings	Curator of Botany, Carnegie Museum, Pittsburgh, Pa.
J. F. Kaylor	American Forestry Association, 919 17th St., N.W., Washington, D. C.
Raymond Kienholz	State Forester, State Park and Forest Commission, Hartford 1, Conn.
Paul Koenig	P. H. Glatfelter Co., Spring Grove, Pa.
F. F. Lininger	Director, Agricultural Experiment Station, State College, Pa.
Robert Lyman	Coudersport, Pa.
James L. Madden	President, Hollingsworth and Whitney Co., 60 Batterymarch St., Boston, Mass.
Perry H. Merrill	State Forester, Forest Service, Montpelier, Vt.
John M. Nelson	The Nelson Co., Standard Oil Bldg., Baltimore 2, Md.

Lawrance W. Rathbun	Society for Protection of N. H. Forests, 9 Capitol St., Concord, N. H.
A. B. Recknagel	107 Cayuga Hts. Road, Ithaca, N. Y.
Harris A. Reynolds	Secretary, Massachusetts Forest and Park Association, 3 Joy St., Boston 8, Mass.
Quentin Reynolds	General Mgr., Eastern States Farmers Exchange, West Springfield, Mass.
Raymond E. Rendall	Forest Commissioner, Forest Service, Augusta, Maine
J. R. Schramm	Head, Dept. of Botany, University of Pennsylvania, Philadelphia, Pa.
George L. Schuster	Director, Agricultural Experiment Station, Newark, Del.
W. S. Taber	State Forester, Dover, Del.
C. P. Wilber	State Forester, Dept. of Conservation and Development, Trenton 7, N. J.

V. L. Harper, Secretary, Northeastern Forest Experiment Station, Philadelphia 7, Pa.

STATION ACTIVITIES[5/]

During the calendar year 1946 the Station made rapid strides in converting to a peace-time basis. Except for continuing the war-born job of appraising lumber production to help the Civilian Production and the National Housing Administrations, all efforts were directed toward reviving war-interrupted studies and to starting new work authorized by the Congress as of July 1946. Work during the first 6 months was confined to the most essential field activities and to participation in the Forest Service nationwide Reappraisal of the forest resource. The Director and two division chiefs spent full time in Washington and several other members of the staff applied full to part time in the field on this project. As preparation for renewing normal and expanded station activities after the war, the reappraisal information gathered and analyzed was timely. It has made possible a sounder orientation of research effort to the most urgent forest problems.

The second 6 months saw expansion in station work in the fields of forest management, forest survey, and flood control surveys. The Station now carries on its work under four subject-matter divisions of its program: Forest Management, Forest Economics (largely Forest Survey), Flood Control Surveys, and Forest Utilization Service. Closely coordinated with these activities are the research programs of the U. S. Department of Agriculture's forest entomologists and forest pathologists assigned to the Northeast. Brief accounts of activities, by subject matter breakdown follow. (See preceding section for highlights of some of the research results).

5/ This section of the 1946 Annual Report is for limited distribution to the Washington office of the Forest Service, and to cooperating agencies and individuals interested in the Station's program in more detail than given in the foregoing section.

FOREST MANAGEMENT

Remodeling old programs and organizing new research in forest management fell heavily on the station staff. The job was tackled with three basic considerations in mind.

1. The need for pilot-plant tests of timber management practices. Past studies have been almost exclusively on a small sample-plot basis. This work has been productive and, together with data from other agencies, from administrative studies, and from experience, has furnished a fairly satisfactory basis upon which to draw up rules of practice acceptable for crude forest management. But the time has now come for testing this knowledge by pilot-plant operations, that is, by larger size cuttings in which not only silvicultural knowledge may be put to test, but in which additional knowledge may be obtained on yield, mortality, logging practicability, costs of operation, and financial returns.

2. The need for basic research oriented to urgent problems of forest production. It is expected that pilot-plant operations directed at rather intensive forest-management practices would indicate where knowledge is still lacking or inadequate and should therefore be accompanied by supplementary sample-plot or project studies. Planting studies in some areas, economics and utilization studies both on and off experimental forests, watershed protection studies, and tree breeding should be continued or expanded to the extent needed and feasible. Special studies to develop sound management measures to control forest pests ranks especially high in New England and New York. Watershed problems are becoming increasingly more critical.

3. Many problems in the management of the forest resource for its services--timber, water, recreation, wildlife, and range--have important aspects peculiar to a forest province (major watershed or forest type). Accordingly, whenever feasible a competent corps of research technicians should be located at research centers (branch stations) convenient to field work in a given province.

Altogether, the Station has 11 such actual or planned research centers throughout the Northeast, all bound together under a correlated regional approach to problems. They are:

1. Penobscot Branch.--Northern Maine. Characterized by considerable old growth spruce, fir, and hardwoods. Office at Bangor, Maine.

2. Upper Connecticut Branch.--Northern New Hampshire and Vermont. Primarily young growth spruce, fir, and hardwoods. Mountainous. Office at Laconia, N. H.

3. Adirondack Branch.--New York. Mixtures of Northern Allegheny hardwoods and spruce and fir. Office at Long Lake, N. Y.

4. Eastern White Pine Branch.--Lower Maine, New Hampshire, and Massachusetts and the Champlain Valley of Vermont and New York. The valuable white pine-hardwoods type. Office at Alfred, Maine (Headquarters on the Massabesic Experimental Forest).

5. Anthracite Area Branch.--Pennsylvania. Depleted oak, pine, and northern hardwoods forests in and adjacent to the anthracite coal fields. Office at Kingston, Pa.

6. Chesapeake Branch.--Maryland and Delaware. Piedmont oak-pine forests. Office at Laurel, Md. (Headquarters on Agricultural Research Center Experimental Forest).

7. Allegheny Plateau Branch.--Pennsylvania and southwest New York. Allegheny high plateau hardwoods and hemlock forests.

8. Coastal Oak-Pine Branch.--New Jersey and northward along the coast to Cape Cod. Coastal plain forest of oak and pine.

9. Mohawk Branch.--Southern and central New York and western Massachusetts. Extensive farm woodland region.

10. Delaware Basin Branch.--Delaware River drainage of Pennsylvania, New York, New Jersey, and Delaware. Heavily exploited hardwood forests and critical watersheds.

11. Bituminous Area Branch.--West Virginia and southwest Pennsylvania. Appalachian hardwoods. Mountainous territory.

Only the first six of the above are equipped with personnel on a full-time basis. The next three receive at least part-time attention--enough to maintain some of the existing experiments started before the war. The last two greatly need research but get none. The financial situation does not yet permit undertaking work on all of the urgently pressing problems.

The programs under way are as follows:

Penobscot, Upper Connecticut, and Adirondack Branches

Although these three subregions differ in many of their soils and forest problems, they have one problem in common--the current threat of the spruce budworm. Also, although these three branch offices are getting under way with programs that differ in detail, the work of the current year has the same general objectives:

1. Development of budworm hazard maps and techniques of rating relative susceptibility of stands. This is an emergency phase of the Station's budworm-control studies which seeks to determine priority of areas to be logged so that stands most vulnerable to budworm damage may be cut first. In this way it will be possible to reduce losses if the budworm attack sweeps the Northeast. Aerial photos and forest-type maps are being used to prepare vulnerability maps for the spruce fir regions within these three forest subregions. These maps will show the general location of budworm hazards and problem of accessibility. Techniques are being developed also for rating relative susceptibility of stands to budworm damage so that landowners may make more detailed vulnerability maps of their holdings.

2. Development of basic silvicultural measures to improve stand resistance to budworm attack consistent with the goals of increased growth, proper regeneration, and required stand structure. Included are:

   a. Intensive studies of the behavior of various types of trees in different environments and under different degrees of budworm attack.

   b. Correlation of attack with age, vigor, density, and composition of stand.

   c. Determination of brood trees and the extent to which they endanger surrounding trees.

   These studies are fundamental to the development of better methods of building up stand resistance to budworm attack. Results should show how to convert mixed balsam fir and spruce stands to stands with a high proportion of spruce. They should show how to produce a vigorous growing stock. These appear to be the essentials of budworm-resistant forests.

3. Development of practicable management measures including costs and returns. Cooperating companies on whose land most of the cutting experiments are being located are keeping cost records. These large scale cuttings represent several grades of cutting methods, each felt to have some promise as effective budworm-control measures. Also included are studies of costs and yields of ridding areas of overmature and decadent balsam fir, the so-called budworm brood trees. Logging companies have previously left such trees because of low wood value. The object is to find a method of cutting that will prove both an effective means of warding off budworm damage and an effective means of increasing growth and yields of these forests.

The major portion of the management research is on fairly large experimental areas; some is on small sample plots selected over the region to study specialized problems. A number of experimental areas, ranging in size up to several hundred acres, are on private land and the studies are carried out in close cooperation with land owners and logging concerns. Five such areas are at present under budworm attack of light, medium and heavy infestation. Since these study areas sample the varying growth and stand conditions of the region they provide the conditions needed to observe the effect of different types of cuttings under varying degrees of budworm attack. Our records will begin with the initiation of attack and will continue throughout the outbreak as well as following subsidence or exodus of the insect to determine the relative success of the cutting methods. Since the program of cutting methods calls for a wide range in volume removals, the experimental areas also provide the conditions needed for costs and yield studies.

Three larger experimental forests are planned or are under way, one in the Adirondack Area, one in the upper Connecticut River watershed of Vermont and New Hampshire, and one in the Penobscot drainage of Maine. These experimental forests will range in size up to 3,000 acres. On them, management experiments will be conducted on an intensified scale under careful control of cutting budgets, products harvested, and volume and quality growth. Detailed records will be kept on cull and mortality and special attention will be given to the relative values of different silvicultural treatments to decrease damage from budworm and other forest pests, to lessen the dangers of windthrow, and to increase growth rate. The experiments will include various harvest-cutting systems, will explore the desirable length of cutting cycle and level of growing stock in the residual stand and will determine the feasibility of stand improvement and other cultural methods.

Only a relatively small proportion of the spruce-fir and hardwood areas support pure stands of spruce and fir. On at least 80 percent of the area beech, birch, and maple occur in mixture with spruce and fir. The presence of these hardwoods greatly complicates the management problems in this forest type. No treatment of spruce and fir can be undertaken without taking into account its effect on the hardwood component and vice versa. But the problem has become still further complicated by widespread decadence and dying of yellow and paper birch and heavy mortality of beech. With the very meager knowledge available on the basic causes of these conditions and methods of control, the effects of any treatment of these hardwoods that can now be presented is unpredictable to say the least.

Some attention is being given these hardwoods problems under the research program outlined above. However, effort is needed, aimed directly at the birch decadence and other problems of northern hardwoods. These problems should be tackled as soon as the financial condition permits.

Eastern White Pine Branch

Work in this important forest type, which extends from Maine south along the coast and into New York, has been concentrated so far on the Massabesic Experimental Forest at Alfred, Maine.

On July 1, 1946 this Experimental Forest was reopened with a three-man staff in residence. This tract of over 3,600 acres of white pine and hardwood land is typical of some 10,000,000 acres in private ownership. It is being put under pilot-plant management to determine the best methods of converting such stands to highly productive forests.

On a well stocked "farm forest" of 40 acres we plan to cut the annual growth every year and keep adequate records of yield, costs, etc. In addition 30 blocks of about 120 acres each are being broken into 20-acre lots. Contemplated are 5-, 10-, and 30-year cutting cycles and two over-all treatments aimed at maximum returns from maximum volume growth and maximum returns from growth of trees of high quality. Ultimately the forest, under sustained yield management, should yield about 3 million board feet annually.

Suitable compartments handy to roads are being prepared for easy view of the results of the different methods in use with an eye to future field meetings of local timberland owners, farm foresters, and State District foresters.

Studies of growth, present volume, mortality, and cull are taking considerable time at present. During 1947 preparation of the forest for experimental treatments will continue and some cutting will be started.

Anthracite Area Branch

Management research started in the Anthracite Region in the fall of 1945. The economic study completed the previous year revealed an area of over 3 million acres of forest land characterized by poor cutting practices and frequent forest fires. As a consequence, three-quarters of this area is unmerchantable or below pole-timber size.

The management program under way is as follows:

1. Studies to enable better prediction of fire danger and more effective protection in the Anthracite Region.

2. Studies of growth, present volume, condition, and silvicultural needs of the seven major forest types by sites and condition classes.

3. Search for an Experimental Forest on which several methods of cutting may be tested on a pilot-plant scale.

4. Studies to determine the relative costs in man-hours to improve the various stands with particular emphasis on mine props and lagging.

The fire danger study will continue through the spring fire season of 1947. Progress reports have been distributed to several cooperating agencies. Three sets of maps showing fuel types and ownership lines for the three most hazardous areas in Luzerne County are being used by the Pennsylvania Department of Forests and Waters as a basis for laying out safety strips, eliminating fire nuisances, and establishing other protective measures.

The stand condition study (item 2) has been completed and seven progress reports prepared--one for each of the major types. These will be processed and ready for distribution in 1947. Each report sets forth the current condition of a forest type by sites and stand condition classes; and shows current and estimated future growth according to various hypothetical treatments.

Site-class volume tables have been constructed according to the system devised by Girard and Clement Mesavage for the 15 major species. These were distributed in June, 1946 as Forest Management Paper No. 3, "Site-Class Volume Tables for Merchantable Timber in the Anthracite Region of Pennsylvania." The demand for them has been great.

In obtaining tree measurements for the volume tables, a very practical "pole caliper" was devised to obtain the diameter at the top of the first 16-foot log. A short article describing and illustrating its construction and use was published in the Journal of Forestry. 44(8) : 594.

An experimental forest for the concentration of management research has not yet materialized. Saw-timber tracts of sufficient acreage within a reasonable travel distance of the Kingston headquarters are scarce. One area is under consideration. The search may narrow down to typical pole-timber stands. A tract of scrub oak, so typical of repeatedly burned land in the oak types, is being considered for purchase by the State for cooperative research with the Station.

A cost study just starting will determine the immediate yield, cost, and net revenue of clear-cutting stands below the pole-timber size for small mine props and lagging in comparison with several degrees of partial-cutting in similar stands. The effect of these types of cutting on future growth and development of the reserved stands will be determined.

Local state, private, and farm foresters are making increased use of the Anthracite Area Branch. Several short studies have resulted in worth-while contributions. For example: (1) considerable stumpage within the Region is bought and sold on a stump diameter basis. A Forest Management Note covering the conversion of stump measurement to related measurements at d.b.h. has been prepared for use in conjunction

with the volume tables issued as Forest Management Paper No. 3; (2) Data on cull and mortality for each major species found in the Anthracite area have been developed. These data will be released as a station publication early in 1947. Such information is helpful to farm foresters especially in selecting good crop trees when marking timber for partial-cutting and in predicting future yields of forest stands.

Local demand has stimulated exploratory study of mine-bank planting. Although the time has not yet arrived for large scale treatment of various types of huge spoil banks in the Anthracite area, the need for the "know how" is considered pressing. Legislation concerning the disposition of banks resulting from strip-mining is pending. Within the next few years information ought to be available on planting such banks. A small project is getting under way in cooperation with the Wyoming Valley Chamber of Commerce.

Work at this branch during 1947 will be directed toward finding a suitable experimental forest and putting it in shape for experimental management, completing the fire protection study now under way, and initiating work on mine-bank planting. In addition, a thorough-going problem analysis will be developed which may result in changes in program emphasis; a newly-formed advisory committee participated in by the State Bureau of Forests, the Pennsylvania State College, and interested private agencies and individuals will facilitate this.

Chesapeake Branch

Past work on the Beltsville Experimental Forest has been limited to the preparation of a type map. In 1946, practically all the usable woods roads were put in condition in preparation for management studies on the forest. Work is now being concentrated on cruising, breaking the forest area into blocks and compartments, and preparing a plan of experimental management. This should be completed in 1947, and harvest cuttings should start in 1948.

Four experimental blocks on denuded land are available for tree-planting experiments. Results of such experiments may be useful in reclaiming various kinds of denuded land, such as the strip-mine banks in Western Maryland and Pennsylvania.

Sprout control with chemicals.--Preliminary experiments with ammonium sulfamate and 2,4-D weed killers show that both chemicals may be useful for killing or retarding hardwood stump sprouts.

The two chemicals were used in the commercial products Ammate and Weedone respectively. Water solutions of both sprayed on red maple and scarlet oak sprouts in early May did not effect satisfactory kills. Ammate, the more potent, killed sprouts but did not prevent resprouting.

Both chemicals were then made up in Lanolin and Dowax emulsions, to get better retention on the foliage and to increase absorption of the poisons. These emulsions were sprayed on red maple and scarlet oak sprouts early in August. The emulsion carriers greatly increased the efficiency of the treatment. One year later, all treated oak sprouts had been killed to the ground, and only 2 of 18 clumps were resprouting--both weakly. Maple was more resistant; Ammate killed all shoots, but three of six treated clumps were still alive and resprouting weakly. Weedone only killed back the treated clumps at the tips. Although these treatments look good for oak, all the test clumps were small. Vigorously sprouting stumps of 6 to 12 inches diameter may prove more resistant.

Further trials of stump-killing treatments will be devoted to getting more poison into the stump. If that can be done, control of sprouting from oak stumps and many other hardwoods may be practical. Maple is a special problem that apparently needs a different approach.

Tree breeding.--The last of the pedigreed stock produced at the Northeastern Station in New Haven and grown in a nursery plot at the Beltsville Forest since 1943 was outplanted in permanent field plantations in the spring of 1946. (Lack of labor and unfavorable weather delayed outplanting 2 years.) About 6,000 pedigreed birch were planted at Standing Stone. About 4,700 pedigreed maple, 750 ash, and 330 oak seedlings were planted at the Beltsville Forest. Survival at the end of the first season was excellent, but it is too early to predict successful establishment.

Hybrid poplar.--A "mother block" containing the 58 original selections made by the Oxford Paper Company before 1937 and 52 new selections made in 1945 from the 17- and 18-year-old plantations at Frye, Maine, was established at Beltsville in the spring of 1946. This planting included only 25 roots of each clone, and is not intended to provide large-scale cuttings. The purpose of this "mother block" is to provide a permanent source of cutting stock of all selected hybrids.

Disease resistance studies.--Cuttings of 50 hybrids were supplied to Dr. Waterman of the Division of Forest Pathology in New Haven for tests of disease resistance. Dr. Waterman will test these hybrids for susceptibility to the Septoria canker disease, which some years ago seriously affected poplars at Saratoga, N. Y., and Williamstown, Mass.

New Hybrid poplar selections.--During the summer of 1946 the plantations at Frye were examined for insect and disease resistant individuals. There are many excellent individual hybrids in these 18- and 19-year-old plantations, which have grown to heights of 60 to 70 feet, in some cases at 6 by 6 foot spacing.

Some hybrids are remarkably clean-boled with very small branches and comparatively slight taper. Diameter and height measurements were made in October 1946, and an additional 91 clones were selected for

propagation and testing. Since the Septoria disease has been present at Frye for at least 7 years, some of the 1945 and 1946 selections can be expected to be highly resistant. A total of 201 selected hybrid poplar clones are available for propagation on a large enough scale to make possible tests in many localities throughout the Northeast.

Regeneration and growth.--Research on planting and seeding techniques for revegetation of eroded fields and other difficult sites during the past 4 years has shown that at Beltsville (1) spring planting is better than fall planting, (2) mulching is highly desirable for fall planting and direct seeding of pines, and is essential on infertile sites, (3) only black locust has responded vigorously to mineral fertilizer applied at the time of planting, and (4) except on very compact soil, bar-planting of black locust with fertilizer is as good as planting in large, fertilized holes.

Cloth coverings on fall-sown seedbeds at Beltsville have given slightly better germination and less rodent damage than organic litter mulch. First-year results of seedling-nutrition experiments indicate that organic composts are fully as effective in increasing growth as the best mineral fertilizer treatments, and much less likely to cause injury. It is apparently possible to precondition planting stock to induce drought-hardiness and survival after planting. Application of liquid fertilizer a few weeks before lifting increased the field survival of loblolly pine up to 20 percent, but results with other species have been erratic.

Experiments to improve drought-hardiness of planting stock by stimulating root growth and retarding top growth have been closed. The results are being published in a series of four papers. Results with growth regulators have been mostly negative; the desired results have usually been obtained at the expense of some injury to the tree. Top-coatings of lanolin emulsion and Dowax (without growth regulators) resulted in an average 10 percent increase in survival for all fall and spring plantings. The highest increase in survival (30 percent) was obtained with stock planted early in December. Since these treatments cost less than 10 cents per thousand trees, they offer extremely cheap insurance against planting failures due to bad weather.

Studies of treatments to prevent deterioration of planting stock in storage have been closed. The results are ready for publication. With some hardwoods, such as black locust and red oak, dormancy can be successfully prolonged in unrefrigerated storage by the use of growth regulators; but conifers generally were injured by all treatments strong enough to retard growth. Best results were got when the regulators were applied as a vapor, an aerosol, or a spray; immersion of the trees in a chemical solution seems more likely to cause injury. Coating the tops of trees with lanolin or Dowax, without growth regulators, was beneficial to pines heeled-in out of doors.

Individual tree research.--Fertilizing individual saplings and old trees resulted, after 3 years, in a very small increase in growth of red spruce and white oak; but red pine failed to respond.

Studies to determine methods for hastening healing of tree wounds (accidental or pruning) have confirmed earlier findings that lanolin, when properly blended with resin, crude pine gum, or asphaltum, is superior to the wound dressings used before. A short article on mixing and blending lanolin dressings was published in the Arborists News.

The program of the Chesapeake Branch is as follows:

After 5 years of bare maintenance, work in genetics and tree breeding will be devoted during 1947 to bringing past results up to date. When this has been done, the program will again be aimed toward developing better timber trees in cooperation with the Station's other branches.

Management studies on the Beltsville Experimental Forest will be planned to determine means of gradually converting run-down areas into producing forest stands. Cooperative forest management and wildlife studies are also contemplated on the experimental forest and on the 3,000 acres of the Patuxent Refuge of the Fish and Wildlife Service. Hazard-reduction burning of the old 1942 burn, planned in cooperation with the State Foresters, will include a series of wildlife study plots. It is unlikely that studies on the Eastern Shore Experimental Forest, which is located in a loblolly pine area, will be included in the program for the coming year. (Under cooperative agreement, the State of Maryland occupies the buildings on this forest and protects the area from fire and trespass).

Cooperation of the Maryland Department of State Forests and Parks, which took over the old CCC nursery on the Beltsville Experimental Forest under a cooperative agreement, has aided work at the branch. Cooperation in tree breeding and silviculture are anticipated from the botany department of the University of Maryland, and from the State Extension Forester at the university. Dr. Jonathan Wright, who was appointed to the genetics staff, will have charge of tree breeding work at the Morris Arboretum, in cooperation with the botany department of the University of Pennsylvania.

Allegheny Plateau Branch

A small amount of work is being done at the Kane Experimental Forest. This 1,735-acre tract of second-growth northern hardwoods has yielded information on results of partial-cutting, weeding and thinning, and planting, but the forest itself has yet to be put under intensive experimental management. Closed when the war started, it is now opened only for three or four summer months in order to maintain going experiments.

It has been shown at Kane that average 40-year old northern hardwoods are growing a cord per acre per year; that these stands can be improved in composition, quality, and growth rate by pulpwood or chemical wood thinnings which have a ready market. On one set of plots the growth was increased from 1 cord to almost 2 cords per acre-year over a 10-year period.

It is time to test management methods in this subregion by organizing the Kane Forest into compartments and setting up various cutting cycles for the production of saw timber and pulp and chemical wood thinnings. It is believed that many stands in this forest type are capable of producing ultimately at least 400 board feet per acre-year plus some cordwood from thinnings and other improvement cuttings. Pilot-plant cuttings on the Kane Experimental Forest will be started as soon as the Station's financial situation permits.

Coastal Oak-Pine Branch

Research leading to solution of the problems of managing the coastal oak-pine forest type has always been undermanned. Results are obtained largely through the cooperation of the State of New Jersey's conservation department. It has provided us with a mile-square Lebanon Experimental Forest on the Lebanon State Forest. Conversion of the stands of leftover scattered pine, mixed with a poor quality oak understory, to pure pine is the main problem currently being studied. Methods being tested are controlled burning and mechanical treatment to control the oak components and reduce sprouting.

Results on controlled burning look promising. Silviculturally it appears possible to convert the poor-quality stands to pine much more cheaply than by mechanical means. To date the research has been on the upland oak-pine sites. It should be extended to the pine-scrub oak and the pine swamp-St. Johns sites. In fire protection controlled burning may have a place. Many landowners, farm foresters, and Soil Conservation Service men are interested in this possibility, especially since last summer's "New Lisbon fire" which stopped at the boundary of an area that had been burned in a controlled-fire experiment.

During 1947 a large-scale test of light winter fires for fire protection purposes has been planned in cooperation with the State. Silvicultural tests of conversion by controlled burning and by mechanical treatment will be continued. Ten-year results will be available on some tracts.

Mohawk Branch

A few studies in connection with problems of small woodlot owners are being maintained as part of the Cooperstown forest cooperative project. Improved methods of marking co-op member woodlots for sustained yield, and mill studies of volume and grade recovery from logs have been carried on. It may be possible during 1947 to establish a few small studies on the Hopkins Experimental Forest, which is situated in the northern end of this subregion of farm and other small woodland owners.

FOREST INSECT INVESTIGATIONS

Spruce Budworm

The Bureau of Entomology and Plant Quarantine received an appropriation of about $200,000 for the current fiscal year (July 1, 1946 to June 30, 1947). About one-half of this amount was allocated to the New Haven, Conn. station and one-half to the Beltsville, Md., station of the Division of Forest Insect Investigations.

The work program for the New Haven station, under the direction of R. C. Brown, has been set up under five projects as follows:

1. Surveys
2. Entomological aspects of forest management
3. Studies of the biology and effects of environment on budworm abundance
4. Studies of parasites, predators, and disease
5. Effects of DDT on the fauna of forests and streams.

Surveys.--Survey work has been carried on under the general direction of H. J. MacAloney and the immediate supervision of R. W. Nash. The situation in the Northeast changed materially in 1946. The infestation in New York (Adirondack Mountains) increased in severity and in several localities defoliation became quite noticeable. Heavy moth flights occurred during the latter half of July. It is estimated that the spruce-fir stands on about 1,100 square miles in this area are heavily infested and those on an additional 2,000 square miles have a medium infestation. Continued heavy feeding in 1947 will probably result in the first tree mortality. In Vermont the collection of caterpillars indicated a decrease in abundance but very heavy moth flights were reported from Rutland on July 19, and Montpelier on July 25. The situation in New Hampshire remained virtually unchanged with scattered collections only from the northern part of Coos County.

In Maine improved collecting techniques resulted in a multi-fold increase in the number of caterpillars collected. Although the general situation is still considered as not alarming the fact remains that the increase in caterpillars collected in Aroostook County merits continued and careful scouting in 1947. A brief survey, by this Bureau, in that portion of the eastern townships of Quebec adjacent to the state lines, indicated a general increase in infestation in that area also.

Entomological aspects.--The entomological aspects of forest management project has also been under the direction of H. J. MacAloney. A large portion of the project leader's time was spent with members of the Forest Service examining proposed experimental cutting areas in Maine, New Hampshire, Vermont, and New York. Since the main project was set up in 1944, 150 1/4-acre sample plots have been established for the purpose of determining the type of stand most or least susceptible to budworm attack and for studying the effect of defoliation and the ability of the trees to recover. These plots have been established under a variety of conditions of site, stand composition and density, age, previous logging and general stand history, etc. These plots, and others to be established as replicates, will be maintained for continued study.

Biology of the budworm.--Studies of the biology of the spruce budworm and the effects of environment on abundance have been carried on under the direction of H. A. Jaynes. Valuable information on feeding habits has already been obtained. The relation of staminate flower production to the build-up of budworm infestations is not yet fully explained. The present epidemic situation in New York has developed in 2 years without the aid of an abundance of flowers. However, there is ample evidence of a heavy crop in 1947 and the feeding habits of the young budworms under this condition will be carefully studied. The 1946 studies indicate that there was little, if any, difference in the final development of caterpillars reared on staminate flowers or on foliage only, and there appeared to be no difference in the fecundity of the female moths which developed under one or the other feeding condition. A considerable amount of time was spent in developing methods for sampling populations and determining the degree of defoliation. Further work must be done in 1947 and if the populations in the New England forests show evidence of increasing in 1947, part of this sampling study will be carried on in this area.

Parasites.--Studies on parasites, predators, and disease have been carried on under the direction of P. B. Dowden. As there are some species of effective natural enemies in the Rocky Mountain Region which are not present in the Northeast, and vice versa, the transfer of such species from one area to the other is being attempted.

Several shipments of parasites were received from Colorado in 1946 and in addition a few colonies of western species were received from the Canadian Parasite Laboratory. All these were liberated in the infested stands in the Adirondack region of New York. Studies of the eastern parasites were initiated and by the end of the 1946 season it was apparent that several species were present in large numbers. Future plans contemplate the liberation of additional material from Colorado and the rearing of eastern species for transfer to the western area. In addition, if the infestation in Maine increases, the rise in abundance of parasites there will also be studied. A small collection of caterpillars from Shin Pond, Aroostook County, Maine, in June yielded one specimen of a parasite specific on this budworm. This area will receive special attention in 1947.

Effects of DDT.--During 1945 and 1946 comprehensive studies in cooperation with state and Federal agencies were conducted to determine the effects of widespread applications of DDT on animal communities. This work is under the direction of C. H. Hoffmann.

One experimental forest area treated with DDT by airplane in 1945 comprised 1,200 acres. In a valley, where most of the biological observations were made, the DDT oil spray was dispersed at the rate of 5 pounds per acre. This dosage was several times greater than necessary for the control of defoliating insects. Large numbers of insects were affected a few hours after the spray was applied. Caterpillars in trees were eliminated, whereas those on low vegetation were reduced in numbers for a short time. Parasites of tree-inhabiting hosts were greatly reduced while those better protected survived. Ants and scale insects were almost unaffected. Aphid and mite populations, however, reached epidemic proportions. From the finding of several affected birds in a small portion of the area the wildlife specialists concluded that the initial kill was high.

Another forest area of 117 acres was treated at the rate of 2 pounds of DDT in oil per acre (actual deposit of 0.6 lb.). Most insect species appeared to occur in usual numbers 2 or 3 weeks later. Biologists of the Fish and Wildlife Service concluded that the short-tail shrew, deer mouse, frogs, toads, and birds were not significantly reduced in numbers. Ninety-five dead fish, mostly fall fish, common shiner, and bluegill sunfish, were removed from a stop-net stretched across a stream at the lower end of the sprayed area.

Pond studies showed that when DDT in oil was used at the rate of 1 pound or more of DDT per acre, most surface insects were exterminated. Certain bottom forms seemed immune. A 3-mile section of a stream was sprayed by airplane with DDT in oil solution applied at the rate of 1 pound per acre (actual deposit 0.23 lbs.). Bottom insects showed a reduction of 90 percent in the lower part of the stream 2 weeks later. A year later, however, a great variety and number were present. Only about 1.3 percent of the native brook trout population was killed. Probably less than one-half of the small warm-water fishes succumbed.

In 1946 a warm-water bass stream was treated with wettable DDT at the 1 pound rate by flying an airplane directly over a 0.9 mile section. The amount of DDT that reached the water was 0.39 pound. This suspension spray did not materially reduce surface or free-swimming insects. The action of the poison on fish was slow and the 60 found dead were killed 3 and 4 days after spraying. This number was insignificant when compared with thousands seen in the stream. Most of the fish killed were less than 2 inches in length.

It seems safe to generalize that 1 pound dosages or less of DDT, which have been shown to be adequate for control of most defoliators, will not cause serious injury to birds or land animals and will probably not cause any very serious or permanent injury to aquatic life.

Aerial Spraying.--The work program for the Beltsville station, under the direction of J. S. Yuill, is being directed toward investigations of aerial spraying.

Preliminary tests have shown that DDT sprays applied from airplanes may be an effective means of controlling spruce-budworm outbreaks. Approximately $100,000 of the current spruce-budworm appropriation was therefore allotted for further development of aerial spraying, the purpose of this work being to develop spraying apparatus, spray mixtures, and flight procedures for practical control operations.

The spray-development work has been centered at Beltsville because of the availability of airfield and laboratory facilities at the Agricultural Research Center. Initial developments are made and tested there and field tests are conducted in the spruce-budworm infestations in the Adirondacks. The Bureau of Agricultural Engineering, U. S. Department of Agriculture, New York Conservation Department, and the Navy have been cooperating in this program.

During the 1946 season, several types of spraying devices have been designed and tested, new methods of testing have been devised, and existing methods improved; and approximately 200 test flights have been made at Beltsville and in the field. Results and conclusions based on current and previous tests are summarized below:

1. A new spray distributing system for light planes has been designed and tested. This equipment is an improvement over any previous equipment in that it will dispense solution, emulsion, or suspension types of sprays.

2. Of the many different atomizing devices designed and tested on light planes, nozzles delivering a cone type or a flat type spray have produced the most uniform deposit patterns. Fine sprays produce a more uniform spray deposit than do coarse sprays but there is greater loss of material from wind drift when fine sprays are used. Further work is needed to determine the most efficient droplet size.

3. DDT sprays are highly toxic to the spruce budworm when applied during the shoot-feeding stage. Sprays applied during the needle-mining stage have not been so effective. Dosage rates ranging from 1/4 pound to 5 pounds of DDT per acre have been tested. Present indications are that the light dosages can be made effective by improving deposit pattern and determining the most effective volume of spray to be applied.

4. Data obtained from various sources indicate that forest areas can be sprayed at a cost of $1.25 to $2.50 per acre. There is every reason to believe that with further improvement in apparatus and spray mixtures large areas could be treated for $1.00 per acre or less.

Progress on aerial spray work to date has been retarded because of difficulty in obtaining qualified personnel, and shortages of equipment and material. The greatest obstacle is the lack of shop facilities at the Beltsville air field. It is hoped that a shop building will be provided for in the next appropriation. A request for this item has been included in the budget estimate submitted by the Bureau of Agricultural Engineering.

Insecticide Investigations

Insecticide investigations under S. F. Potts' direction can be summarized under the headings: Development of power mist-blowers for applying highly concentrated, finely atomized sprays at small quantities (1½ to 4 gallons) per acre; development of concentrated spray mixtures; particle-size tests of new insecticides; field tests; and evaluation of results against various pests.

Two sizes of large power blower-atomizers were further improved by the cooperative efforts of the New Haven station and the Connecticut Agricultural Experiment Station. One is a 12-hp. machine for treating orchards and the other is a 25-hp. outfit for treating tall forest and shade trees, and plantations. A small 120-pound wheelbarrow mist-blower was developed which also has a wide range of application.

Over 500 acres were treated experimentally with the above equipment; they comprised approximately 150 experimental plots in 8 different states. Effective control was obtained of about 35 pests, including the gypsy moth, brown-tail moth, Japanese beetle, white pine weevil, elm leaf beetle, cankerworms, eastern and forest tent caterpillars, pine sawflies (Neodiprion sertifer), elm leaf beetle (Anisota senitoria, S. albicosta), birch leaf skeletonizer, and fall webworm.

Insecticides applied included DDT, Gamma hexane, Velsical "1068", lead arsenate, cryolite, derris, derris resins, pyrethrum extract, and 99 percent nicotine alkaloid. Fermate and wettable sulfur were applied for control of disease organisms. Droplet sizes of 36 to 65 microns diameter were most effective.

Good control of such insects as leaf hoppers, pea aphids, gypsy moth, and pine sawfly larvae could be obtained several hundred feet from the machine. However, certain other sucking forms can only be killed by blowing the vines over so as to contact the foliage and insects with a heavy deposit on the under sides of the foliage. Control of such insects is limited to the distance that the air blast can agitate the foliage (50 to 100 feet) and best results are obtained by blowing the insecticide from opposite sides of the plants. Foliage injury can be avoided by using the proper mixture and proper drop size.

As many as 100 to 200 acres can be treated per day with a mist-blower at a cost of about 85 cents to $1.00 per acre. To enable the larger machines to travel through plantations of greater than 400 feet in width, lanes or roadways should be provided at distances of 400 feet apart throughout the plantations.

Insects Injurious to Forest Plantations

During the past 3 years studies have been carried on by J. V. Schaffner, Jr., in cooperation with the New York Conservation Department to develop practical ways and means of controlling insects injurious to forest plantations. The major problems involved were in northern New York on state reforestation areas where the red-headed pine sawfly (Neodiprion lecontei, Fitch) was causing serious damage to red and jack pines and the white pine weevil was killing a large percentage of the main leaders of conifers, principally white pine and Norway spruce. Biological and ecological studies of these insects were carried on in addition to experiments for their control by the aerial application of DDT.

The red-headed pine sawfly.--It has been learned from the studies that the adults begin to emerge during the fourth week of May, that the maximum emergence occurs during the first 3 weeks in June, and that adults from overwintering cocoons may continue to emerge until the first of August. The incubation period may extend over a period of 16 to 34 days. Such information is of importance in making up spray schedules so that the applications will be properly timed, particularly when an insecticide such as DDT is to be used and a residual effect is essential. It was found that DDT at the rate of 1 pound in 1 gallon of solution per acre gave excellent control when sprayed from an airplane in July. The most effective dates for the application will vary somewhat from year to year depending upon the westher in the early part of the summer.

Epidemics of this insect in plantation of red pine and jack pine occur along the outer edges of stands, or where the seedlings have been widely spaced, 6 x 6 feet or wider, or where there has been poor survival of the seedlings. The populations seldom build up to a point where severe damage is caused before the plantations are 5 to 8 years old and very little damage is caused by this species in closed stands.

White pine weevil.--The 1946 program included the spraying, by means of an airplane, of some large areas of white pine and Norway spruce in forest plantations for the control of the white pine weevil. The aim is to protect young plantations by one spraying so that the majority of the trees will reach at least one log length with straight stems. In order to be practical one application of an insecticide must so reduce the weevil population that it cannot build up again to serious proportions for several years. The spray, to be effective, must be applied when the adults are active. It has been determined

from observations in northern New York that the adults begin to emerge from hibernation during the first warm days late in March or soon after the frost is out of the ground, and that their progeny mature and begin to emerge from the infested leaders in August. Effective periods for applying insecticides, therefore, are early in April before the females lay their eggs, or in August and early September before the young adults enter hibernation.

Between March 29 and April 10, 400 acres (4 plots of 100 acres each) were sprayed with DDT, using a different dosage or formula on each plot. Between August 17 and 22, 1225 acres in Jefferson and Lewis Counties, New York, were treated with DDT. This acreage included one plot of 900 acres and 5 plots varying from 25 to 100 acres in extent. The large plot was sprayed at the rate of 2/3 lbs. of DDT in 1 gallon of solution per acre. Other formulas and dosages were used on the smaller plots. The results from these tests cannot be determined until another season has passed.

The best results thus far, from the spray applications, indicate as high as 85 percent control was obtained when 1 pound of DDT in an emulsion was used at the rate of 1 gallon per acre. It is believed this is not adequate to prevent a build-up of infestation in a very few years. Further study of the treated plots and more tests must be made before definite recommendations can be made.

FOREST PATHOLOGY

During the war years, the Division of Forest Pathology of the Bureau of Plant Industry, Soils and Agricultural Engineering adjusted its work program for full emphasis on war research problems. Branch offices in the Northeast, under the direction of Perley Spaulding, collaborated in a general survey of repair centers where wooden boats and airplanes were reconditioned. This work culminated in the release of several papers on the decay of wood in boats and in aircraft, with recommendations for structural changes to prevent decay. A study was made of the comparative decay resistance of the principal species of oak used in boat construction. The significance of the discolorations occurring in the wood of the most important tree species used in airplane construction was determined by microscopic study and toughness tests of affected samples. A study was made to determine the relation between decay susceptibility of selected tropical woods and the toxicity to fungus growth of the water soluble extractives from the same woods. Methods were developed for curing chestnut oak and hemlock tanbark in ricks in the woods, to avoid excessive moisture resulting in molding and loss of tannin.

A serious canker disease of hybrid poplars has been found to be caused by the fungus Septoria musiva. This attacks the living leaves, then goes downward through the petiole into the basal twig, where it forms a canker in the bark. Then it often progresses into the main stem, and girdles it. It also directly infects stems through lenticels, soon causing canker formation at the entry point. The damage may be aggravated where Cytospora infects the cankered tissues. Tests are under way to determine the susceptibility of the most desirable hybrid clones.

Investigation of sapwood decay in living sugar maple and beech trees damaged by a severe ice storm in central New York the third summer after the storm, in cooperation with the forester in charge, showed the damage was caused by Daedalea unicolor. This fungus has been found to be a real parasite after making entrance into a tree through some injury. The injury in this case appeared to be caused by sunscald near the base where suddenly exposed by heavy breakage of branches and dying of adjacent trees. The dying, scalded bark provided conditions especially favorable for this fungus to attack and cause considerable damage. Salvage of badly broken trees is advised within 5 to 10 years to prevent loss from decay that starts in broken branch stubs and extends into the trunk.

A brief disease survey was made of the Dartmouth Grant in northern New Hampshire to assist in providing data with which to formulate management plans.

A blight of current season's twig growth of Abies balsamea and ornamental species of Abies in New England and New York was for several

years believed to be caused by Rehmiellopsis abietis of Europe and British Columbia. Careful study shows our northeastern fungus to be different. It has been named R. balsameae. It is widely distributed in natural stands of balsam fir and apparently has spread to ornamental firs. The diseased twigs resemble those killed by late spring frosts and doubtless have been overlooked because of this resemblance. How serious continued killing of young twigs may finally be is uncertain as severity of attack varies from year to year.

On species of Picea, particularly P. pungens, a serious needle cast has been found on trees in plantations or used as ornamentals in the eastern United States. The fungus Rhizosphaera kalkhoffi, has been isolated from the diseased needles. The needle cast has been reported on P. pungens in Canada and in Europe and also on P. excelsa in Germany and France. It first attacks the needles of the lower branches and gradually progresses up the tree. No cases of the death of entire trees has yet been observed in this country and the growth of the upper portions of affected trees seems to continue at a normal rate. The significant damage lies in the weakening and death of the lower branches. A brief account of the disease is being prepared for publication.

A leaf spot of Acer negundo, A. saccharum, and A. pseudoplatanus in Connecticut, New York, and Pennsylvania, has been found to cause severe premature defoliation, particularly on the first named species. A new species of Cristulariella was found on the spots and a description of it is being prepared for publication. The disease has been under observation for only a few years. The extent of its distribution and its importance are not yet known.

Yellow and paper birch are dying from unknown causes in New England and the Maritime Provinces of Canada, and in Maine and New Brunswick total loss of these two species is imminent unless control measures are instituted. The bronze birch borer is consistently associated with trees in the final stages of decline but proof that it is the primary cause is lacking. Present evidence indicates that some other factor or complex of factors reduces birch vigor sufficiently to favor successful borer attack, thereby allowing the borer to multiply rapidly. Injury by the borer in previously weakened trees is considered by most entomologists to be sufficient to cause death eventually. Field surveys of the dying of birch in Maine and in Canada have been made; and conferences have been held with pathologists, entomologists, foresters, land owners, and federal, state and provincial officials. A program for cooperative research has been recommended to determine the primary cause of birch mortality and its control through forest management and other means.

FOREST ECONOMICS

Forest Survey

Recognizing that the forests play a vital role in the economic and social life of the nation, Congress passed the McSweeney-McNary Act of 1928 authorizing a nation-wide forest survey. This survey was intended to provide a field inventory of the existing supply of timber; to find out the rate at which this supply is being increased by growth; to determine the rate at which it is being diminished by commercial cutting and by losses due to destructive agents such as fire, insects and forest diseases; to determine the present consumption of forest products and estimate future needs; and to interpret these data in terms of private and public policy that will promote an effective and rational use of land suitable for forestry production.

In the interim since 1928, the initial inventory has been completed in the Pacific Northwest, in the Lake States, and in the South. First, the depression and then World War II intervened and hindered the job. However, in July 1946 it got under way in the Northeast under a plan of operation that involves close collaboration with state foresters and with a number of the larger forest land owners.

The absence of up-to-date cruise information for the bulk of the Northeast forest land, the sparse and scattered nature of much of the timber stand, and the need for reliable information on comparatively small areas make it imperative that the Northeast survey be intensive. The most economical way to get that intensification is through the use of aerial photographs. Cooperating state agencies and private forest landowners have already given tentative assurances of cooperation with a cash value of about $350,000. This takes the form of the purchase and loan of aerial photographs now in existence, of flying certain areas that are not presently covered by adequate aerial photographs, and of collaboration in the aerial photo interpretation and ground cruise checks. Such cooperation makes possible a far more effective use of the Forest Service funds and personnel devoted to the survey. It also makes the new survey techniques more readily available to state agencies and to private forest owners.

The actual field work began in a pilot project covering the Dartmouth College Grant in northern New Hampshire. The college and the Charles Lathrop Pack Forestry Foundation cooperated in this first survey. Two crews trained on the Dartmouth Grant were then transferred to Hancock County, Maine, where another pilot project was completed. The State Tax Assessor, State Forest Commissioner, and several private landowners cooperated by providing new aerial photographs of the most up-to-date type. By December the photo interpretation and field check work in this county was complete. The crews then shifted back to southern New Hampshire where the first state-wide survey got under way.

Other crews have begun work in New York and in West Virginia. A gross area of about 3 million acres had been covered by December 31, 1946. By the end of 1947 the State of New Hampshire should be complete. Work will probably be started in Vermont and resumed in Maine. Further substantial progress will be made in New York and West Virginia. There may be a start of the survey in Pennsylvania. Statistical reports for a number of counties will have been completed.

Forest Cooperatives

In recent years the Station has had a considerable interest in forest cooperatives. Most of this work has been centered at Cooperstown, New York, where we have had responsibility for the administration of a government loan to the Otsego Forest Products Cooperative Association. This co-op has about 950 members--most of them owners of small farm woodlots. It operates a sawmill, does most of its own log hauling and some of the timber cutting on members' woodlots. Part of the lumber produced is sold back to members at wholesale prices, but the bulk of it is sold in the open market. The basic objective of this cooperative is to encourage better management of small woodlands through an agency for the processing and marketing of timber owned by its members. This timber-management aspect of the cooperative's activities was originally carried on largely by the Forest Service as a free timber-cruising and tree-marking service accompanied by advice on woodland management. As the co-op has developed, it has taken over practically all of this job. The Forest Service now serves only as advisor on the management activities.

In 1946 OFPCA made arrangements for settlement of the government loan and for refinancing through cash advances from members and others supplemented by a new loan from the Springfield Bank for Cooperatives. This operation greatly reduces the capital obligation and the annual interest charges. The prospects for future success by this cooperative are bright. With the signing of some final papers in the near future the Station's administrative responsibility will end. The cooperative's board of directors have, however, requested that the Forest Service continue research that will aid in the solution of the many problems of the small woodland owner. The OFPCA will continue to make its records available for analysis in research projects.

The Cooperstown experience has pointed up most of the basic advantages and weaknesses of forest cooperatives. A field study of member and nonmember attitudes has been completed and is now about ready for publication in a report entitled "A Forest Cooperative and What Woodland Owners Think of It." A number of milling studies have also been made at the co-op mill. One of these dealt with the yield of lumber from hardwood and hemlock logs of various diameters. The report shows that the values recovered from hardwood logs increase with log diameter but not so with hemlock. The large hemlock logs are heavily defective. Another study provides milling cost data on logs of various diameters, lengths and species.

The matter of cash return to woodland owners who do their own logging has always been an important factor in farm woodlot management. A study based on Cooperstown experience is nearing completion.

The difficult problems yet to be solved at Cooperstown include ways and means for the removal of low-grade trees from member's woodlands, rehabilitation of depleted and deteriorated woodlands, coordination of forestry and grazing so that one will not continuously be sacrificed for the other, and the fundamental problem of many tension areas--the conflict between sub-marginal agriculture and intensive forestry. All of these are major problems which can best be tackled by a forest-management research center.

Realizing that the Cooperstown cooperative is unique in many ways, the study of forest cooperatives was broadened in 1946 to cover all of the Northeast and the inactive as well as the active organizations. A report of this study is in process. It reveals that forest cooperatives have had hard sledding, especially during the war years, and that the amount of good forest management resulting from them has been relatively small. From this study the indications are that the real strength of OFPCA lies in its processing plant which serves as a vital core maintaining the continuous interest of members.

Special Projects

Forest taxation.--Assessment of forest land for taxation purposes has long been recognized as a difficult job. This is especially true in the Northeast where woodland holdings are predominantly small and often interspersed with lands used for other purposes. The State Tax Assessor of Maine has been interested in the possible uses of aerial photographs and maps of forest conditions as an aid in the improvement of assessment work. This interest led to the aerial survey of Hancock County, Maine, which has previously been mentioned. Personnel of the Station and of the Washington office in cooperation with the Tax Assessor, made a detailed study of three towns. The analysis showed a poor relationship between the current assessed valuations and the timber values actually on the lands. It shows that up-to-date information on the condition of the timber stands can be obtained from aerial surveys and that this can be used as the basis for more equitable assessments. A report on the results of this work should be ready in 1947.

Farm forestry.--The Norris-Doxey Farm Forestry Research Project has been carried on in Connecticut in cooperation with the Department of Forestry, Agricultural Experiment Station, and the Forest and Park Association. The chief interest has been in the improved utilization of low-grade timber through better harvesting methods and equipment. Three specific studies have been carried on.

One of these was designed to determine the most economical method for skidding fuel wood--whether in 4- or 5-foot bolts or in

tree-length sticks. The usual practice is to move the short bolts on a sled. The time studies that were made show that skidding the wood in long lengths behind tractors is cheaper. Sticks from 20 to 30 feet long are preferable to longer lengths.

One of the pressing problems in Connecticut and in other sections of the Northeast is the thinning of plantations which are rapidly stagnating due to crown closure. This problem was studied in several red pine plantations in Connecticut. The age of crown closure ranged from 15 to 18 years for a 4-by-4 foot spacing and 23 to 25 years for a 10-by-10 foot spacing. This study indicates that it is worthwhile to prune the crop trees prior to the removal of the thinnings. One of the difficulties in thinning has been the lodging of trees that are felled. A proposal that selected rows in the plantation be entirely removed appears to have considerable merit. A truck road through the plantation can thus be developed with space for felling more trees in later thinnings. This problem needs considerably more investigation.

Another major problem in Connecticut and in most other farm woodland areas is the procurement and training of woods workers. Profits from the harvesting of timber often disappear because of poor efficiency in handling material between the stump and the processing plant. An attempt to set up some reasonable criteria for judging efficiency in the loading of pulpwood was made in 1946 through a time study of one experienced crew. The operation included loading the wood on a dray and hauling to a landing, loading it on a truck, hauling 4.3 miles to a railroad siding, and loading in box cars. The labor expenditure on this total operation averaged 1½ man-hours per cord. This job was done under piece-work contract.

Quarterly estimates of lumber production.--Wartime scarcities of lumber and the need for current information on requirements, production, and supplies gave rise to the so-called RPS project--a joint undertaking of the War Production Board and the Forest Service. The Forest Service has carried on the field work and compiled monthly reports on volume of lumber produced and influences that have been affecting the output of sawmills. The tight supply situation which continued after the war was over prompted a continuation of the RPS first by the Civilian Production Administration and more recently by the Office of the Housing Expediter.

The monthly estimates have been made by a small field force which works on a sampling basis. Reports are obtained from a certain percentage of the total sawmill population. This is supplemented by a complete census of certain small areas to give an indication of the extent to which mills move out of the area and new ones come in. The results of this method are reasonably reliable for areas as large as New England and the Middle Atlantic States. More intensive work would be necessary to give a comparable accuracy for state units.

FOREST UTILIZATION

The Forest Utilization Service unit, set up at the Station 2½ years ago, functions in close teamwork with the Forest Products Laboratory. This provides the basis for a rapidly expanding service to persons and companies concerned with the harvesting and processing of timber products. About 1,500 inquiries from the Northeast reached the Laboratory and the Station's FUS unit in the past year. Each of these contained a request for some kind of technical information on timber harvesting or processing. Each was answered by a person who has special knowledge on the subject of the inquiry. Usually the reply is accompanied by one or more published bulletins which contain pertinent information.

The major activities of the three men assigned to the Station's FUS unit in the past year can be grouped under four headings: (1) timber harvesting, (2) air seasoning and kiln drying, (3) utilization of hardwoods by the pulp industry, (4) secondary milling and fabrication of timber products.

In the field of timber harvesting, the chief project has been the preparation and release of the "Northeastern Loggers' Handbook" in a preliminary review edition, issued in 17 separate sections. Twelve of these are out and the remaining five are in the editing and processing stage. Subjects covered include loggers' hand tools (including power saws), the felling, bucking, skidding, loading, and hauling of timber. Demand for information of this sort has far exceeded all expectations. About 7,000 copies of each section have been sent out in response to requests. Many more persons and agencies have been asked to wait for the future printed edition. Pulp companies, sawmill operators, trade associations, state forestry associations, forestry schools, farm and extension foresters are among the agencies that have asked for quantities of the handbook separates. Five sections have been republished as articles in timber products trade journals.

Studies of the wood-turning industry made in 1945 showed that air-seasoning and kiln-drying practices are not very good. The industry is aware of this fact and is very much interested in new and improved methods. The Forest Utilization Service cooperated with the Laboratory and with the University of Maine in offering a 2-weeks course on modern dry-kiln operation. This was held at Old Town, Maine, with 26 men in the course. The reception was so good that there is demand for two, and possibly three, similar courses in the coming year.

Again, with the Forest Utilization Service taking the initiative in working out cooperation, the Laboratory and Stowell-MacGregor Corporation of Dixfield, Maine, undertook kiln-drying experimental work on white birch and other turnery stock. The Laboratory provided

a technically competent operator and a small experimental kiln which was set up at Dixfield. This work resulted in the development of kiln schedules which reduce kiln drying time by a substantial amount. The information is being put into bulletin form. Another feature of this project was a "visitors' day" attended by 80 persons from 48 woodworking plants. The experimental kiln has now been loaned to the University of Maine, where further experimental work is being done on thick beech turnery stock, shoe last blocks, and other specialized products.

Desirability of increased use of hardwoods by the pulp mills has long been recognized. A systematic over-all survey of the problems involved was made in the past year by personnel of the Forest Products Laboratory and of the Station's FUS unit. A majority of the pulp mills were visited and problems were discussed with research men and plant managers. A number of new research projects have now been started at the Laboratory and at several of the mills. A general report on the problems of hardwood utilization by Northeast pulp mills is in preparation.

One member of the FUS unit gives special attention to secondary milling and fabrication. Inquiries in this field run heavily to gluing methods, use of ultra-high frequency electric current in drying and gluing, use of infra-red heat in drying, sources of supply for dimension stock, factory layout, and yard equipment for handling lumber and dimension.

FLOOD CONTROL SURVEYS

The Flood Control Act of 1936, as approved by Congress, authorized the U. S. Department of Agriculture to make preliminary examinations and surveys on watersheds for retardation of runoff, erosion control, and water conservation. This act and subsequent acts listed the authorized watersheds. The list now includes all the watersheds in the Northeast.

Work was started throughout the United States in 1937 and several surveys were completed before flood-control activities were halted by executive order because of the war. In 1946, under instructions from the Bureau of the Budget, flood-control surveys by the Department of Agriculture were resumed. Responsibility for this activity was assigned to the Forest Service and the Soil Conservation Service. A division of responsibility between these two agencies has been made on a watershed basis, depending primarily on whether the major land use is forest or agriculture. However, both of these agencies cooperate in the flood-control survey of any watershed. In the Northeastern region the Experiment Station has been designated as the agency of the Forest Service to conduct the surveys.

The Flood Control Act provides a basis for cooperative financing of remedial projects with state and local agencies. Any proposed remedial program, however, must be justified by expected benefits resulting therefrom, and must fit the economy of the watershed. Survey procedures involve the collection of all available data and information from as many sources as feasible. Any gaps in needed data must be filled in by field work, which may involve both intensive and extensive field checks, usually on a sampling basis.

If a flood-control remedial program is justified it will be predicated largely on proper land-use management. However, supplementary benefits may be included in a program justification such as recreation, fish and wildlife, and water conservation. These factors will, therefore, receive consideration in the surveys. In locations where local damages are severe and cannot be controlled by land-use practices, small upstream dams, channel improvements, and dikes will be considered.

Recruiting and training of personnel was begun in July 1946. At the same time actual work was started on a flood-control survey of the Lower Connecticut, including that portion of the watershed below the confluence of the Farmington and Scantic rivers. It includes the main river and all tributary streams from that point to the mouth of the river. This area was selected because hydrologic analyses by the U. S. Army Engineers determined that runoff from these tributary streams entered the main stream and passed to sea before peak flood water reaches this point. However, flood damages on these tributary

streams are high, which indicates that a flood-control program might be justified. The area includes not only highly industrialized sections but some of the better farm lands in New England. The necessary field work for this survey was completed in 1946, and the analysis of data and writing of the report is scheduled for completion by early 1947.

The next watershed to be surveyed will be the Merrimack River in New Hampshire and Massachusetts, and field work in this watershed is expected to start early in the spring of 1947. Some advance study work on this watershed was done this year. The purpose of advance studies is to outline the problem as clearly as possible and to compile a work plan for the Survey. Such studies develop the sources of all existing pertinent data and where necessary provide for filling in of missing data required for a well-rounded flood-control survey.

LIST OF RESEARCH PERSONNEL

VERNE L. HARPER, Director; Marian M. Thomas, Secretary; C. Allen Bickford, Statistician; Edwin vH. Larson, Editor.

ADMINISTRATIVE SERVICES

GEORGE A. CASHION, in Charge; Hazel L. Stiles, Roland M. Kendall, Josephine S. Smith, Emma W. Schoenfeld, Florence M. Hendrick, Annette M. Forbes, Mary C. Jardine, Helen V. Geniszewska, Harold C. Muldoon, James Harris.

DIVISION OF FOREST MANAGEMENT

RAYMOND F. TAYLOR, Chief; Vanda A. deCamara, Secretary.

Silviculture.--Marinus Westveld, Silas Little, Ashbel F. Hough, Frank E. Cunningham, Horace A. Somes.

DIVISION OF FOREST ECONOMICS

FRANK A. INESON, Chief; Harriet A. Magargee, Secretary; Helen M. Haggerty, Pauline K. Rubin.

Forest Inventory.--Harry W. Camp, Earl J. Rogers, William Rutherford, Jr.

Statistical Services--Roland H. Ferguson, Kathryn R. McKinnon, Emma L. Warfield, Flora J. Gano, Margaret C. Sweeney, Mary Aitken.

Drafting Services.--Fred J. Hartman, Robert H. Mohr, Fay C. Gershuni, Jesse L. Pearson.

Resource Analysis and Industry Studies.--Kenneth M. Clark, J. Willcox Brown, Ted J. Grisez.

Financial Aspects of Forest Management.--

Special Projects, Cooperstown, N. Y.--Allen W. Bratton, Francis M. Rushmore, Harry B. Price.

Forest Survey Field Project, Forest Service Building, Laconia, N. H.--George B. P. Mullin, Alessio P. Caporaso, Joseph J. Mendel, Robert B. Pope, Malcolm J. Williamson, John H. Zerbe, Richard S. Colgan, Adrian M. Gilbert, John H. Noyes, John F. Nigro, Tudor Richards, Thomas K. Connors, Frederick E. Hampf, Richard H. Fenton, Joseph W. Frescoln, Leo Perks, Ruth O. Hanna, Clerk-stenographer.

Forest Survey Field Project, Forest Service Building, Elkins, W. Va.--Carl J. Holcomb, George E. Doverspike, Irvin C. Reigner, Alvin K. Wilson, Thomas G. Clark, Clifton F. Barr, Fred R. Green, Beatrice A. Marsh, Clerk-typist.

DIVISION OF FLOOD CONTROL SURVEYS

ARTHUR BEVAN, Chief; Christine W. Harris, Secretary.

Advance Studies.--Sidney Weitzman, Theodore C. Flint, Robert L. Hobba.

Land-use Classification.--Norman E. Hawes, George R. Trimble, Jr., Nedavia Bethlahmy, Donald R. Gedney, Miles H. Cubbon (SCS)

Hydrology.--Donald E. Whelan, John B. Cavallero, Sam A. Hutcheson

Watershed Appraisals.--Howard S. Potter, Wayne G. Banks.

FOREST UTILIZATION SERVICE

JAMES C. RETTIE, Chief; Beatrice M. Delaney, Secretary

Seasoning and Physical Properties of Wood.--Roy M. Carter

Timber Harvesting and Conversion.--Frederick C. Simmons

Cooperative Farm Forestry Project, Connecticut.--Donald H. Archer

BRANCH STATIONS

PENOBSCOT.--Thomas F. McLintock, Coe Building, 15 Cross Street, Bangor, Maine; John R. McGuire, Earl M. McChesney, Frederick H. Berry, Walter J. Kidd; Lucile G. Cristo, Clerk-stenographer.

EASTERN WHITE PINE.--_____, Massabesic Experimental Forest, Alfred, Maine; William E. Parsons, Richard M. Goodman.

UPPER CONNECTICUT.--Victor S. Jensen, Forest Service Building, Laconia, N. H.; Thomas W. McConkey, Arthur C. Hart, Raymond W. Ellstrom, Eugene W. Wilton, Wendell N. Ellsbury; Ralph I. Atkinson, Statistical Clerk.

ADIRONDACK.--John R. Curry, Long Lake, N. Y.; Garold W. Pugsley, Edwin H. Weil, Jr., Thomas W. Church, Jr., Eli J. Fenchak; Robert E. Jennings, Statistical Clerk.

ANTHRACITE.--Chester F. Burnham, Post Office Building, Kingston, Pa., Miles J. Ferree, David F. Baum, Stanley M. Filip; Bernard F. Carey, Clerk-stenographer.

CHESAPEAKE.--Ernst J. Schreiner, RFD No. 2, Laurel, Md.; William E. McQuilkin, Jonathan W. Wright, Harold F. Ford, Ralph P. Broomall.

FOREST ENTOMOLOGY

R. C. BROWN, in Charge Field Station, Division of Forest Insect Investigation, Bureau of Entomology and Plant Quarantine, 335 Prospect Street, New Haven 11, Conn.; H. J. MacAloney, P. B. Dowden, J. V. Schaffner, Jr., S. F. Potts, H. A. Jaynes, R. W. Nash, David Crosby, J. L. Bean, C. F. Speers, V. M. Carolin, Jr., J. E. R. Holbrook.

FOREST PATHOLOGY

PERLEY SPAULDING, in Charge Field Station, Bureau of Plant Industry, Soils and Agricultural Engineering, 360 Prospect Street, New Haven 11, Conn.; J. R. Hansbrough, Glen G. Hahn, Alma M. Waterman.